The Photo-Miniature

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Failures—and Why: In Negative Making

In a recent issue of THE PHOTO-MINIATURE, No. 143, I brought together the simple processes which can be used for the remedying of negatives which are defective from one cause or another,—negatives, that is, which by suitable means can be brought into a condition in which they yield reasonably satisfactory prints. The intention in that monograph was clear enough to me, as I hope it was to my readers. It dealt only with failures in negative-making which, with more or less complete success, could be put right afterward. Thus it included methods of intensification and reduction, stain-removal, retouching, blocking out, the restoration of broken negatives, the working up of flat and hard negatives, the treatment of halation and the like,—in short, all the defects of common occurrence in negatives which at the time of making are not so utterly useless that they are cast forthwith into the waste-box. Useful as I believe that manual to be, it is clear that many matters of even greater importance to the beginner could have no part in its scheme. For the defects which are remediable are far outnumbered by those which are not. It is of no use to shut our eyes to the fact that, simple as the photographic process has been made, there are still plenty of opportunities for failures through some unsuspected fault in apparatus, through misuse, or through sheer carelessness.

The Field of This Adventure

In the present monograph we take up this wider subject, with the aim not of prescribing remedies—for in most cases, none exist—but of pointing out the possible causes of failure, which usually is all that is necessary to prevent their recurrence. The essential thing in a manual of this kind is to describe the defects as precisely as one can, and to adopt some kind of arrangement which allows the reader in doubt to turn quickly to the list of photographic disasters gathered together for his benefit. Hence I have adopted a scheme which sets forth, item by item, the chief things which can make a negative useless. To know and avoid these things will mean more successful negatives hereafter.

No Cause for Dismay

Let not my reader think this list so formidable that only by some fortunate heaven-sent miracle may a good negative result. Here I am at pains to anticipate as completely as I can all the things that can happen, which have in fact happened at one time or another, to the discomfiture of individual and often isolated workers; but, as will be seen in the pages which follow, it is against all probability that they can occur in any number together. It is usually one single, simple thing that is at fault. Hence my desire to include all really possible causes of failure, even at the risk of giving this monograph the appearance of "frightfulness."

The Man Behind the Gun

For the larger part of what follows I am indebted to Mr. George E. Brown, editor of "The British Journal of Photography," and thus for many years past in constant touch with the troubles which arise in practical photographic work. Some years ago, Mr. Brown under the pen-name of "Scrutator," wrote a manual on very much the same lines as the present volume, but, beyond similarity in scheme, the two have very little in common. We all realize how enormously photographic conditions have changed since twelve years ago. Many of the causes of failures in exposure, development, fixing, etc., are now much more completely understood. The plain purpose of this monograph is to present in orderly, usable shape our present knowledge of the

causes which in ordinary circumstances may lead to different specific failures. Many a beginner is disheartened by the apparent mystery of failures. Obviously there must be a reason for each. The expert worker is expert simply because he has learned to recognize them. I believe the present monograph will enable the beginner rapidly to attain the same skill.—[EDITOR.]

GENERAL FOG ON NEGATIVES

The Fault The negative has, in addition to the image, a more or less general deposit which may be so dense as to obliterate the image almost completely or may only be of such degree as to make the negative so flat as to be useless for printing. Flatness from moderate over-exposure or under-development may be remedied by intensification, but not the excessive flatness due to general fog.

The Causes This fog may arise from several causes, which I will briefly summarize. Where the remedy is obvious the reader can apply it for himself; in other cases remedies are suggested according to circumstances.

Gross Over-Exposure Gross over-exposure of the plate or film, for instance by mistaken use of the full aperture of the lens instead of a small stop, or by giving a "time" or "bulb" exposure in mistake for a short fraction of a second. In these circumstances, the fog will be very heavy and dense, the image on the plate or film flashing up in the developer and speedily becoming lost in the general fog.

Light Leakage Light may reach the plate through some hole in the camera, e. g., around the badly fitting lens-panel of a stand camera, or through a gap between plate-holder and camera back, due to worn condition of the velvet facing on the latter.

Testing the Camera The best way to test for leakage of light into the camera is to lead an electric bulb into the camera, first from the front and second from the back, in each case using a

focusing-cloth to cut out escape of light from the lens-tube or raised focusing-screen, respectively. Then in a darkroom you can readily locate the place where light gets in by noting where it gets out. Turn the camera around and about whilst the lamp is in.

Precautions A strip or two of velvet on the back of a lens-panel, a patch of thin black cloth in the inside of the bellows where a crack or pinhole may leak light, or renewal of the attachment of the bellows to front or back of camera—these are the three chief minor repairs which will preserve the light-tightness of the camera. I am speaking now of the field type of instrument.

Fog from light-leaking apparatus will often be erratic in its occurrence, making itself evident only when strong light falls upon the camera from a particular direction. The fog may be absent altogether from negatives exposed on a dull day, but may recur when the camera comes to be freely used in bright sunshine.

Roll-film Camera Troubles In the case of roll-film cameras, the back or cover of the spool-chambers and of the space between them may become bent, and fail to make a light-tight joint with the back of the camera body.

Also, again, with roll-film cameras there is danger of fogging the film when threading it into the camera. The daylight spool is as nearly fool-proof as any contrivance can be, nevertheless there is limit to the liberty which can be taken with it. If you can, choose a subdued light in which to load the camera. It is true that you *can* thread the spool in full sunlight, but the chance of light creeping under the edge of the black paper is proportionately greater.

For the same reason, keep the paper tight on the spool whilst fitting the taper end to the empty (winding) spool. By these precautions you will avoid the dissatisfaction of negatives spoilt by fog extending for a greater or less distance either side along the band of film.

Internal Reflections The folds of the bellows, or parts of metal or wood within the camera, may reflect light on the plate. Both are apt to wear bright with use, metalwork in particular,

and then require a coat of dead black, such as can be bought ready for use or made by mixing thin celluloid varnish and methylated spirit or wood alcohol (about equal parts of each), with addition of enough fine lamp-black to give a dead black surface.

It is often astonishing to find the amount of fog from this cause, more especially with modern lenses of large covering power, which thus light up the interior of the camera. This unsuspected trouble is responsible for many of the unfavorable comparisons made between anastigmats and cheaper lenses.

The Remedy In some cases, the only cure is to fit frame, a or diaphragm, of black card in the camera (about half-way between lens and plate), with an aperture in it of the same shape as the plate, but smaller. This frame stops rays from reaching the hinder part of the bellows: reflection from this portion is the chief cause of fog.

Defective Shutter Leaves A possible cause is transmission of light through the thin ebonite leaves of the shutter when a plate is left uncovered in its holder for long whilst the camera remains in strong light. Not a common cause.

When a shutter is defective in this way, the fog is more likely to take the form of a central disk, due to the camera remaining closed with the sensitive surface uncovered and close against the shutter. Experienced in the early days of folding film cameras but rarely met with now.

The only prevention is to have new leaves fitted to the exposure shutter.

Keep Your Lens Clean Dust on the lens causes fog. Part of the light is scattered or diffused as it is by a piece of ground glass, instead of all rays passing sharply through the lens to form the image. Result: general veil over the negative. Preventive: see that the lens surfaces are bright by polishing, best with a piece of soft paper, e. g. papier Joseph.

Flare Spot The lens itself may cause a veil over the whole plate, due to its having a "flare spot." With a small stop, this flare spot takes the form of a circular patch of fog on

the negative; with a larger aperture, this patch may spread over the whole plate as less intense general veil.

This, like the preceding cause, arises chiefly when photographing with the sun facing the camera more or less directly.

Shading the lens with a hood is a partial preventive, but the lens calls for attention by the maker, who often can cure its defect by altering the position of the stop.

Plate-Holders

With plate-holders, fitted, as they usually are, with pull-out shutters, or slides, fog will be caused by replacing the shutter wrongly. The wrong way is to insert one corner of the shutter first. This may leave a gap either side of the part inserted, through which light can strike. The right way is to set in the shutter with the edge to be first inserted evenly in touch with the end of the holder, i e., just so far in that it is ever so lightly caught by the velveted slit in the holder. Then thrust quickly home without jerkiness.

Another plate-holder point. No matter how good your holders may be, never expose them (when loaded) unnecessarily to strong light. If you watch a practised photographer, you will notice that he takes a holder out of the case under cover of the focusing-cloth, and that he grasps the end of the shutter, when withdrawing it, also through the focusing-cloth. It is a habit, and a good one, a detail in the making of fine negatives.

Fog by Chemical Emanation

New plate-holders will sometimes cause general fog as a result of emanations from resinous matters in the wood, or to the use of an unsuitable varnish. Turpentine is an active agent in causing developable fog in plates, and varnishes containing it have the same effect. Fortunately, fog from new wood or varnish is caused only when plates remain in the holders for some considerable time, usually days.

Moreover, holders can easily be got into non-fogging condition, viz., by exposing them with the shutters withdrawn to strong light out-of-doors for a day or two, or by painting the interior with a solution of permanganate of potash.

The same kind of fogging action is caused by some

metals, of which brass is about the only one used for plate-holders. It *is* occasionally so used for apparatus intended for the tropics. The cure, in this case, is to clean the surface and paint the metal with a weak solution of platinum bichloride.

Safe Changing and Dark-Room Light

Unsafe darkroom light used in loading plates into holders, or when developing, will cause fog. The light may be unsafe from leakage of white light into the darkroom. In this case, the obvious remedy is to place oneself in the darkroom (with no ruby light) for five or ten minutes, when any leakage of light will be evident. No need to feel undue fear of faint white light beneath doors: it is without effect. But a pitfall which should be guarded against is direct light coming from such a position that it is caught by the developing-dish, but is not detected by the eye, owing to the low level from which it comes. A piece of looking-glass, the size of the developing-dish or larger, should be laid in the sink or in various places on the working-bench, if there is thought to be need for detecting light from points such that the eyes cannot be placed to meet it. But more usually is the result of the unsafe nature of the "safe-light" itself.

The all-glass filters used in cheap darkroom lamps are often quite unsafe, even for ordinary plates, because they pass blue light. It is best to chose a safe-light consisting of dyed films bound up between two glasses, and to have one of decent size (8 x 10 inches), so as to be able to work in comfort a few feet away.

Treacherous Ruby Fabric or Glass

Another cause (easily unsuspected) of an unsafe darkroom light is the gradual fading of a ruby fabric used as a safe-light with daylight. A ruby window in a darkroom which afforded a safe illumination at the start may readily become quite unsafe after a summer's exposure of the fabric to the strong light outside. For this reason, it is well if this illumination is used for the darkroom, to make up the fabric screen with a thickness of yellow material outside, as this affords very great protection to the ruby cloth behind it. This applies also to "ruby" incandescent lamps.

But daylight is best avoided altogether as the source of light for the darkroom, since its ordinary variations are inconvenient, even if at its brightest it does not fog plates.

And, remember, no light is absolutely without action on plates or film, which should therefore be exposed as little as possible in the darkroom.

Fog in Development Developers may cause fog from being wrongly compounded, e. g., too much alkali or not enough bromide, or from being too warm.

Practically every plate is all the better for half a grain of potass. bromide per ounce of developer: some require more in order to yield negatives free from veil.

Too much sulphite in the developer is a cause of fog. Formulas should be made up by weighing, not by guesswork.

Hypo in the developer, from dirty or cracked dishes, or splashes from the fixing-bath, is a fairly certain cause of fog, although developers vary greatly in their susceptibility to contamination by hypo. Pyro is the developer which fogs most easily with hypo: others, such as metol, will stand more, but with none can you rely on being lax as regards the chemical purity of the developer without getting fog.

Another cause of fog in development is mixing different developers. If you add any developer made up with alkali to one of amidol, which works with sulphite only, you are pretty sure to get fog. So, also, if developer containing caustic alkali is mixed with one made up with carbonate.

Often, with an under-exposed plate, one is tempted to try the addition of whatever other developer happens to be at hand, but such forcing with a haphazard mixture is pretty certain to develop fog, and nothing else.

65° F. is the best average temperature for development: 70° F., a degree of warmth which it is well not to exceed. If the material temperature of surroundings is anything above 70° F., there is need of ice in the solution or, failing that, extra bromide up to 3 or 4 grains per ounce of developing solution.

Important Note Where plates are carried in ordinary holders, a valuable hint as to the cause of general fog is conveyed by the appearance of the narrow band at the edge of the plate, where the sensitive surface is protected by the rebate or the spring clips of the holder. If these edges keep clear in the developer, then clearly the cause of the fog is to be sought in the camera or the lens; at any rate, in something which acted on the plate as it was held in its position in the holder. But, if the fog extends to the edges of the glass, we have reasonable evidence that the cause was due to the developer, or to exposure of the plate to an unsafe light when out of the camera.

General Fog This is caused by exposure of the film or plate to light before it has become perfectly fixed. My experience is that fog from this cause is of rare occurrence; but, on the other hand, I have come across plates which were very susceptible to it. With perhaps nineteen plates out of twenty you can be safe in letting daylight of moderate strength gain access to the fixing-bath as soon as the plate has begun to fix without ill effect; but, all the same, those are conditions which favor fog of this kind, and I heartily endorse the emphatic recommendation of one plate-maker to avoid all access of white light, not only until the plate is fully fixed but until it has been rinsed from the fixing-bath.

UNSHARP NEGATIVES

The Defect Described It is hardly necessary to describe this defect as a woolly or fuzzy appearance of the outlines of the picture image in the negative. Instead of the edges being sharp, they are softly blurred and shade off, with the result that fine details run into each other and are lost. In other forms, the fuzziness may be due to several sharp images separated by a minute distance. The first is due to misuse of the lens; the second to movement. The use of a magnifier will instantly show the difference between the two varieties.

Diagnosis

The two forms arise from altogether different causes, whilst negatives which are sharp in some parts and fuzzy in others suggest still other origins of the failure.

Also, in searching for the cause of regular unsharpness of negatives made in a particular camera, one must keep in mind the working conditions. Conclusions which apply to a tripod camera, with which as a rule one focuses on the ground, do not always hold good in application to hand cameras where one focuses by setting the lens at some point on a scale. Diagnosis of fuzziness sometimes presents some perplexing problems, but I will endeavor to put down the possibilities in full.

Plates

In using plates in holders or sheaths there is always the chance of loading the plate-glass side to the lens. A silly mistake, but the most careful of us make it at times. It is bound to result in a slightly fuzzy negative, unless the exposure happens to be made, with a small or medium stop.

Again, with plate-holders, the holder may not "register" with the focusing-screen; that is, the surface may not come into exactly the same position as the ground-glass as regards distance from the lens.

Locating the Trouble

The best way to locate this fault in the apparatus is to lay a stiff flat ruler (a steel rule) across the plate-holder, with the shutter drawn and a waste-plate in position. Then push a finely tapering piece of card edgewise under the rule, and mark on it where the edge of the rule stops it. Repeat the test, which is a delicate one, with the focusing-screen, laying the rule across the surface of the frame of the latter which faces the lens. The taper card should stop at the same point. If it doesn't, it is a job for the camera repairer to alter the focusing-screen frame.

With plate-holders of the British book pattern, a simpler plan for testing is to focus on some printed matter (with the full aperture of the lens), and then, without touching the focus, to put one of the holders into place, having previously fitted a piece of ground-glass, matt side outward, in the position of a plate. On

pulling out the shutter, pressing the ground-glass against its rebate, and using a magnifier, you can at once detect any want of focus.

Focusing-Screen Coarseness of the focusing-screen is another cause of general unsharpness, for the reason that you can't be certain that you have got sharp focus, even though you use a magnifier.

One often comes across absurdly coarse ground-glass fitted to cameras, so coarse as to make really accurate focusing a matter of chance.

A little vaseline rubbed over, and nearly all rubbed off again improves the screen somewhat, but the best thing is to fit a finely ground glass, such as the dealers supply if you insist.

Look to the Lens Dew or moisture on the lens is a cause of blurred definition, which may be very puzzling until the conditions under which it is formed are realized.

A cold lens brought into a warm room will thereby get a deposit of moisture on its surface through the chilling of the air in contact with it. The trouble is liable to occur only when the place is both warm and highly charged with moisture, e. g., a conservatory or palmhouse.

The preventive is to warm the lens by giving time for it to come to the surrounding temperature, or helping matters by keeping it in one's pocket for a while.

Spherical Aberration The lens itself may be the cause of this general unsharpness, due either to its spherical aberration or, more rarely, to its being non-achromatic.

Spherical aberration, in a word, is the defect in a lens whereby rays passing through the margins are brought to a focus nearer than those passing through the center. Thus it is removed by the use of a small stop which cuts out the marginal rays.

In these days of high-grade anastigmat lenses, it is not likely to trouble the worker as it did when R. R. doublets were the lenses in general use. But, with a lens of this type, it may happen that a view which was focused sharply at *f*/8 becomes perceptibly unsharp

on stopping down to $f/16$, or vice versa. With such lenses the focusing should be done, or at any rate checked, with the actual stop to be used for exposure. This does not apply to the more modern and perfect anastigmats, in which defects such as spherical aberration are practically non-existent.

Non-Achromatism This defect is different, and again is met with only in the older lenses. It is that the image seen and focused as sharp on the screen comes out fuzzy on the negative, due to the fact that, with a lens with this defect, the blue rays, to which the plate is chiefly sensitive, come to a focus nearer than the more visual rays, to which the eye is chiefly sensitive when focusing.

The Remedy A smaller stop is no remedy. The only means, when using a focusing-screen, is to rack inward, after sharp focus has been obtained, a distance about one-fortieth of the focal length of the lens. It is only single (spectacle) lenses which possess this defect, and even with them it is of no account in hand-cameras which work at one set focus, or are fitted with a focusing-scale, since provision is made for the difference in focus in fitting the lens or the scale. But when taking advantage of the spectacle lenses, which can be bought very cheaply in a wide range of focal lengths, neglect of this want of coincidence between the "chemical" and "visual" foci, as they are called, will lead to distinct fuzziness. With due allowance for it, these cheap lenses yield beautifully fine definition over a narrow angle.

Focusing-Scale In a hand-camera, either film or plate, the focusing-scale may be incorrect; or, on the other hand, you may misjudge the distance to which you set the scale. A word may be said as to deciding which of these is the real cause. If the subjects are those situated at "infinity," that is more than 50 feet or so from the camera, then it is pretty clear that the fault is with the camera. Even the most inexperienced can tell whether a thing is really a great distance away, though he may not be able to judge correctly in the case of objects 10, 20 or 30 feet distant.

Also, if the camera is fitted with a lens working at a comparatively small stop, say *f*/11 or *f*/16, unsharpness is more likely to be due to some gross mistake in the fixing of the scale on the camera than to error in judging the distance, for the reason that, at such apertures, the depth of focus is so great as to nullify a good deal of misjudgment of distance.

But with large-aperture lenses, and when setting the focusing-scale to 10, 15, or 20 feet, unsharpness is more likely to be due to error of judgment than to fault in the camera. Doubt in regard to this point may be set at rest by measuring out, say, 15 feet from the camera to some well-defined object, such as a poster on a boarding, setting the scale to 15 feet and making an exposure or two.

Movement of the Camera From any of the foregoing causes, the unsharpness will be marked by a general fuzziness of outline. Other causes, as already stated, lead to unsharpness of another kind, due to movement of the camera in some way or other during the exposure. The tripod camera may be shaken when taking off the cap, particularly when using one of the light metal stands, which are not rigid.

The Tripod Slips A more common cause, in the use of a stand camera, indoors or when a lengthy exposure is given out-of-doors, is gradual slipping of the tripod legs on a polished floor, or sinking of the legs into soft ground.

Shutter Jar Some shutters, too, will set up a positive jar when released, a ready test for which is to lay the shutter (set) on a polished surface, preferably glass, and release it with the pneumatic bulb or "Antinous" fitting. A good shutter will lie perfectly motionless under this test, whilst a bad one will give itself a perceptible jerk.

Movement in the Hand With a camera held in the hand, blurring from jar may arise from too nervously clenching the camera in the aim of holding it steadily. It is only necessary to give a firm but rather slack grasp.

The same ill effects follow from using the shutter at too low a speed. Few people can hold a camera in the

hand and give as long an exposure as one-fourth second. Most will do well to make one-tenth second the shortest exposure, in the absence of some firm base for the camera or side support, such as a wall against which it can be pressed with one hand.

Local Unsharpness In all the foregoing instances of unsharpness, the defect will extend to all parts of the subject which is recorded on the plate. With one qualification, however. An incorrect focusing-screen or an error in judging distance may lead, not to general unsharpness, but to parts of the subject other than that focused for being rendered sharp whilst the important parts come out fuzzy. But, generally speaking, a faulty scale or unskilfulness in judging distance means unsharpness, at any rate of the essential part of the subject.

But now I deal with negatives in which parts may be noticeably unsharp, whilst others are satisfactorily rendered as far as definition is concerned.

With Moving Objects First, where there are moving objects in the subject. These will be blurred if the shutter is too slow, more especially when the object is fairly close to the camera, or is moving across the direction in which the lens is pointing. An object such as a street-car, train, or horseman may be obtained sharp with a moderate speed of shutter, if moving directly or almost directly toward the camera. The speed of one-fiftieth of a second which is the top speed of many shutters, even though marked one-hundredth, will often suffice, but for such subjects *across* the line of sight, a focal-plane shutter is necessary.

Lack of "Depth" in the Lens Too large a stop is a cause of parts of the negative being unsharp, due to lack of depth. For explanation of these various lens defects see THE PHOTO-MINIATURE No. 140.

Depending on the focal length, a stop of from *f*/8 to *f*/32 or *f*/45 is necessary to secure sharpness of both near and distant objects. For lenses up to 4 inches focus, *f*/8 gives great depth; up to 8 inches, say *f*/11 to *f*/16; up to 12 inches, say *f*/22 and beyond that, *f*/32 or *f*/45.

Swing-Back Angling of the plate to the lens-axis, as when using the swing-back of the camera, is again a cause of unsharpness over part of the plate, unless a small stop be used in the lens. Keep the plate absolutely parallel with the lens board or front.

Drying with Heat Drying a negative by heat will cause patchy unsharp effects, due to the actual melting of the gelatine. It will occur only when drying a negative before a fire or over a gas flame, always a risky proceeding unless it has been thoroughly hardened with alum or formaline, and, in the case of film, one which is pretty certain to ruin the negative by the buckling of the celluloid.

SPOTS AND MARKINGS ON NEGATIVES

Minute White Spots These, when observed in the finished negative, are caused by dust on the plate or film at the time of exposure. Spots from this cause are recognized by their very small size. They are not so large as a pin's head—more nearly the size of the point of a pin. And, if you examine them under a magnifier, you will see that they are not circular, but of all descriptions of shape. In these respects they differ from spots due to other causes—of which in a moment.

Film negatives are, on the whole, more free from spots by dust than those on glass plates, as might be expected from the perfect protection of the film until the moment of exposure.

With Fixed-focus, Bellows Cameras But I would mention one cause of a perfect plague of dust-spots on film by way of caution. I have met it on film-packs, for the reason that cameras of the kind which readily give it are usually made to carry a film-pack.

This is the folding camera which extends on two pairs of struts and is fitted with a lens-shutter. The bellows harbors dust like any other, and, if the camera be closed

vigorously with the film surface uncovered, a shower of dust is thrown on the latter, and will make itself known by minute white spots on the film which is next exposed.

Remedy Cameras, whether for film or plate, should be dusted out every now and then with a soft, damp cloth, racking the bellows of a stand-camera out to the full and wiping into the corners. The apparatus is the most prolific source of dust, yet it is constantly neglected by workers who dust plates with meticulous care.

But plates, as taken from the makers' wrappings, are remarkably free from dust, and it is a mistake to do more than give the edge of each a smart rap on the bench before loading into the plate-holder. Worst of all is to "dust" them with a camel-hair brush, which infallibly puts on far more dust than it takes off.

Larger White Spots These are due to air-bells adhering to the plate during development. Such spots are larger—of the size of a pin's head, or sometimes larger still—and are circular in shape. Moreover, under a magnifier the edge of the spot is seen not to be sharp, but to have a shaded or vignetted outline, due to the developing solution gradually encroaching on the space of the air-bell during the process of development.

Remedy The more strongly the developing solution is charged with air, the greater the tendency to the formation of these spots. Water drawn at high pressure straight from the faucet and used for diluting stock developer solutions is very liable to cause them. The best course is to boil water and let it cool quietly. A good plan—and one calling for very little trouble—is to keep a stock of this boiled water in bottles filled to the neck. The spots then should not occur if the developing solution is kept rocked as soon as poured over the plate.

The positive preventive of these spots is to go over the plate with a wad of absorbent cotton as soon as the developer has been applied. But be sure you provide a small dish or graduate for the cotton, since it can easily do more harm than good if it is given the chance to pick up hypo by being laid on the bench when not in use.

These air-spots are more liable to occur if the plate or film is soaked in plain water before applying the developer to the plate.

Spots of Irregular Shape

Sometimes one meets with a regular crop of spots of various irregular shapes occurring generally "in close formation" along one side of the plate but sometimes widely over the whole plate. These are caused by stale developer. That is to say, by developer made from stock solutions which have "gone off" with age or by a mixture of stock solutions which has stood too long before use or has been used for too many plates in succession.

Clear Spots of Bare Glass

These are the result of pits or holes in the plates when purchased, defects of manufacture which a maker generally is most ready to admit.

These marks are sharply distinguished from other clear spots by being bare of gelatine. Each is a tiny pit with a wall of gelatine round it, as may be recognized by probing it with a fine needle.

Comet-shaped Spots

These sometimes appear with heavy fog. It is a special form of spot, which is perhaps of rare occurrence, but may be a puzzle until the process of its formation is apprehended. The spots usually occur in numbers on a ground of more or less heavy fog.

The cause of the fog is access of light to the plate from some leakage in the holder near to the emulsion surface. The light spots arise from the shadows of particles of dust lying on the plate in the path of these low-running rays of light. The preventive is obvious.

Colonies of White Spots

Although somewhat remote from every-day conditions I should mention here the white spots caused in negatives by bacteria. Many bacteria cause gelatine to liquify, which action may be exerted on the sensitive material or on the finished negative. In the latter case, soaking in a 1 per cent solution of thymol or carbolic acid has been prescribed as a preventive for use in the tropics.

Actual eating of the gelatine by small insects will perhaps be put aside except by those who have met

with it. I have come across several instances of both negatives and prints being disfigured in this way, in some cases whilst negatives were drying, in others after they had dried. In the former case, drying within a muslin-covered frame is a preventive. In countries where ants are a pest, an effective means of avoiding their attacks is to stand the feet of the drying-rack containing the negatives in a shallow dish of water.

Dark Spots These are most commonly caused by particles of dry developer on the plate before development or to solid undissolved particles of the developer proper in the solution. The defect often arises from imperfect solution of a developer in tank development.

In dissolving, as many still do, the pyro and amidol at the time of developing the plates and film, both of the above causes may arise.

Minute fragments of developer may fall directly on uncovered sensitive material when one is mixing developer by the ruby light or may be scattered for a time in the air, afterward to settle on an exposed emulsion surface.

Chemical Dust Then again, developer or fixing-bath may be slopped on the floor and left to dry, afterward to be ground under the feet. Fine particles may then escape into the air, there to become floating dangers to any plates which may be left uncovered.

The sure preventives of these evils is to avoid weighing out or dissolving the developing chemicals themselves in the darkroom, to mop up slops on the floor or bench with a wet cloth, and every little while to have a thorough clean up of all parts of the darkroom, where chemical solutions have had a chance to leave a solid residue by evaporation.

Solid matter in the developing solution may be due to the extra-cold state of the sulphite stock in which pyro and amidol is dissolved.

Neither of these developers dissolve with the extreme readiness of the light resublimed form of pyro; the crystals require to be well stirred for a minute or more.

Developer Deposit These dark spots may arise, too, from deposit found in the developer after its use for a number of plates or after standing for a time. It is false economy to use a developer which is at all muddy, for any deposit is very liable to mark the negative with dark spots.

Some stock solutions of developers will form a deposit, capable of yielding dark spots, unless care is taken to leave it undisturbed at the bottom of the bottle when mixing the working developer. The best plan with such stock solutions is to pour off from the deposit into a fresh bottle a day or two after making up.

There is no certain means of removing dark spots caused by developer except by the skilful use of the retoucher's scalpel but it is worth while trying. Some workers advise the application of a bath of water to which a little nitric acid is added; caution must be used as regards quantity of acid (add a drop or two at a time for there is danger of separating the emulsion film from its support as also of rotting the gelatine).

Iron Rust Still another cause of dark spots is iron rust in the water-supply used for rinsing plates before and after fixation. This defect is now rarely encountered.

The preventive is to filter the water through a flannel bag tied to the faucet, or through one of the convenient anti-splash fitments, containing also some cotton packing, for the purpose of arresting suspended dirt.

Iron spots, like those caused by developer, are difficult to remove. About the best means is to dab the part of the negative with a half and half mixture of hydrochloric acid and water, for a second or two, immediately rinsing with water and applying the acid mixture again. The latter must on no account be left on the film or it will almost certainly cause it afterward to separate from the glass.

Yellow or Brown Spots If these are circular in shape and surrounded by a clear ring, they are due to non-action of the fixing-bath as the result of air-bells sticking to the plate while in the hypo. The remedy is obvious: Keep the plate free from air-bells.

The Cause The cause of these spots is that the emulsion, protected by the air-bell during the development, does not become softened and therefore fixes more slowly in the hypo.

Hence the plate as a whole may be completely fixed whilst still retaining minute dots of undissolved creamy emulsion, which are liable to be overlooked in the darkroom. The clear ring is formed by the part of the protected disk which fixes out by diffusion of the hypo solution from the surrounding emulsion.

If the spots are noticed within a short time of taking negatives out of the hypo, they will fix out (clear) on putting back into the bath but the proper preventive of course is to clear the plate completely of air-bells whilst in the developer, as already directed when speaking of white spots.

Light Bands The bands of light, usually clear, running right across the negative in one direction or the other, can often be traced to their cause by their position on the plate. Omission to draw the shutter of the plate-holder out to the full is one cause which hardly needs to be pointed out.

Another, not quite so obvious, is projection of the baseboard of the camera when using a wide-angle lens. The baseboard cuts off part of the foreground and if itself of dark color may cause an almost clear band across the lower end of the negative.

Plate-Holders In new plate-holders of the British book-form pattern, the material used for the hinge of the shutter will sometimes cause a partial de-sensitizing of plates which are kept in them for any considerable time. The result is a light or clear band, exactly corresponding with the size and position of the hinge.

The holders should be opened out and exposed to full sunlight for a few days, when this defect of the hinge material will usually disappear.

On the other hand the hinge may cause a light band not through any de-sensitizing action, but because it is the only part of the holder which is without action on the plate. As I have pointed out on an earlier page, the

wood of the shutters of new dark slides (English plate-holders) will often fog the emulsion, but the hinge may not; with the result that the band in the plate, corresponding with the hinge is clean unfogged negative, whilst the parts above and below it represent fog from wood.

Moreover, cases have been met in which fog was produced in plates left for a long period in holders or "slides," by means of light actually passing through the shutter. In such circumstances the hinge effectually stops all light, so that, again, its effect is to cause a clean band with veiling of the negative above and below.

I mention these points, not because they are of common occurrence—they are very exceptional—but because it is in the most uncommon difficulties that a hint of the cause is of most value.

Light Bands by Reduction

A light band across one edge of the plate is caused by carelessness in allowing a fixed but unrinsed negative, to project above the surface of water in the washing-tank.

The hypo in presence of air is a distinctly active reducer, and in the course of a quarter or half an hour, will reduce the density of a negative several tones, producing a light band.

The same effect may occur, but in patchy form, on film negatives which are left to fix with parts above the surface of the hypo bath.

Film is far better fixed on a circular disk of sufficient depth to allow the fixing solution to cover the film standing on edge, or, also uncut, in a long narrow tray with room at the ends for narrow weights or clips to keep the whole band under the hypo solution. In my own practice I use a gallon earthenware circular pot, with straight sides, six inches in depth and stand the film in zig-zag curves on its edge, which ensures the fixing of all portions of the strip of film at one time.

Dark Marks of Dense Fog

Generally these occur in the form of a beam from a searchlight or in various shapes on the negative, but with straight edges are usually due to light leaking into the camera from some minute point near to the plate or film. Light travels in straight lines. Hence fog from this cause

often takes the shape of definite beams or rays, broader as the distance from the point of leakage is greater. For these marks to occur it is necessary that the light should enter somewhere near to the surface of the emulsion, that is in the back part of the camera nearly level with or very little in advance of the plate.

Dust Comets While I am referring to fog arising from apparatus let me mention a point which may help to locate the direction in which the light-leakage comes. Sometimes amid the fog little light comet-shaped markings may be seen. They are due (as I have said) to dust on the plate; the marks are really shadows of specks of dust cast by light which falls along a line making a very small angle with the plate. These comets, which are plainly seen under a magnifier, indicate the quarter from which the fogging rays come and their occurrence at all is evidence that this light gets in somewhere at the back of the camera, for example through a warped-back frame or the warped shutter of a plate-holder of the English pattern.

An Unusual Case Another case where a little of the Sherlock Holmes habit led to the source of fog being traced may be quoted by way of example that careful deliberation will often furnish the clue to the most puzzling problem. It was noted that when two or more exposures were made without closing the (film) camera, it was only the first one which had fog marks on it: on closing the camera, the fog recurred in the first of the next lot of exposures. This suggested that light leaked through the leaves of the shutter at such an angle that it did not reach the film with the camera extended but only when it was closed. A small crack around the fitting of a finder was found to cause fog in exactly the same way.

Dark Bands A distinct well-defined band of fog across the glass negative usually has its origin in the plate-holder. If at one end of the plate, the cause is action of light through omission to push the shutter fully home, either when putting in plates or after exposure in the camera.

With plate-holders of the English book-pattern (dark slides) the flexible hinge of the shutter may fog the

plate, the opposite effect to that which it sometimes has of partially destroying the sensitiveness of the emulsion.

This fogging action of a leather hinge (most usually met with in new apparatus) is readily cured by painting the material with a solution of potass. permanganate.

A Narrow Black Line If this runs across the negative it arises from the leather of the hinge having cracked by accident or wear and thus admitting light. Even the solid hingeless shutter of a plate-holder will develop a defect of this kind, not enough to show when examining it in the ordinary way, but discernible on bending the shutter as far as it will go whilst holding it in front of a strong light.

Dark Patches These, usually, patches of density or, more often, of positive fog, may arise from very different causes. They may be caused by the lens or shutter, in which case they are usually circular in shape: or they may be due to faults in development and other operations. Dark patchy markings, produced in these stages of the process, are generally of irregular shape and may be large or small.

Central Fog Patch A dark central patch of fog may be caused by the accidental release of the shutter when the latter has been pushed close against the film or plate.

It may arise also from a defect in the shutter, viz., leaves of such thin vulcanite that on long exposure out-of-doors sufficient light to fog the film passes through the closed shutter. Many folding film cameras of the ultra-portable type have no protection for the lens. The only shield between the uncovered film within and the strong light outside is the set of thin vulcanite leaves in the shutter. No wonder that at times this mishap should arise. Metal leaves are now used by more makers of shutters. The preventive in the case of a shutter which is faulty in this respect is to keep a cap on the lens when the camera is not in use or, if that cannot be done, to carry the camera in its case.

Round or Oval Patches These may occur anywhere on the negative and are often due to the defect of "flare spot" in the lens. Briefly this defect is one which causes a bright and, usually, sharp

image of the lens-stop to be formed on the sensitive film. It most frequently occurs when pointing the lens toward strong illumination (i. e., when photographing "against the light") and when using a small stop. With a larger stop the fog is distributed generally over the negative. Often the flare spot may take the form of several dark rings one within the other.

Preventive

A partial preventive is to shade the lens from direct light falling on the front glass at the time of exposure by means of a hood, or even with one's hand or hat, but the only effective remedy is to return the lens to the maker by whom in many cases it can readily be cured.

Effects very similar to true flare from the lens are caused by metal parts of the lens or shutter wearing bright. The metal cells in which the glasses are mounted on the edges of the fixed or iris diaphragm require attention in the way of touching with a little dead black.

Irregular Dark Patches

If large and situated roughly in the center of the plate, the most likely cause is wrong application of the developer. The solution was probably poured on right in the middle of the plate instead of being flowed on in an even sweep over the whole surface. Adding alkali (accelerator) solution or strong developer to that in the dish instead of mixing in a graduate will, in many instances, have the same effect.

Irregular Drying

Although very much milder in its effect, irregular speed in drying negatives will give rise to patches of extra density. The more rapidly the emulsion film is dried, the greater the density (to a slight but appreciable extent) of the negative. Many beginners are tempted to fill one of the drying-racks sold by the dealers, with negatives which latter then dry very slowly as a result of the restricted access of air to the wet surfaces. Very likely, when the negatives are half-dry, it occurs to the worker to hurry matters by taking out the negatives and putting them in a warmer and more freely exposed position as on a mantel piece. Result, a patch of greater density, marking the area on each which has dried more quickly.

Defective Drying-Racks These drying-racks will serve fairly well if you put a negative only in about every fourth groove but the best drying-stand is a good-sized board with nails driven into it so as to support the negatives in the diagonal or diamond position, film side outward. Negatives should be mopped surface-dry with a bit of soft lintless rag, or better chamois leather, in order to expedite drying and to remove actual drops of water before setting up to dry.

A Helpful Dodge A tip for dispensing with this mopping is to place the negative, immediately after a full rinse under the tap, on a rack which will allow one corner to point downward and clear of everything. The water will then run off without forming drops, leaving the negative in the best condition for drying. It is necessary to see that the surface of the plate is fully covered with water and that the plate is kept with the same corner downward until the water has run off as it will in a minute or two. When many negatives are being handled this is a little dodge which will save a lot of labor.

Dry in a Warm, Dry Atmosphere Another point—don't set negatives to dry in a damp place. The advice sounds unnecessary, but I am constantly finding beginners who fail to realize that an atmosphere which is itself fairly well saturated with water (through water standing about exposed to it) will be very slow in taking up the moisture from negatives.

I know of no method of equalizing the density of a negative which has become patchy, although some workers have declared their success in bleaching with ferricyanide and bromide, as used for sulphide toning, and re-developing with amidol.

Patches of Fog These will often be irregular in shape but differing from those just mentioned in the fact that detail is often buried in fog. These are commonly caused by contamination of the negatives, during development, with hypo.

The hypo dissolves part of the emulsion which instantly is strongly darkened by the developer, depositing heavy fog in the negative.

The ways in which hypo can gain access to plates or

films during development are legion, most of them the result of careless, or at any rate, thoughtless, manipulation.

A negative from the fixing-bath may be allowed to drip over a developing-dish: or a sharp stream of water on a fixed plate may splash hypo to the same destination: or plates may be touched with fingers contaminated with hypo.

Remedy

All these opportunities of failure disappear by the use of a grooved porcelain, glass, lead or wooden tank for the fixing bath into which each plate can be let slip without the fingers once touching the hypo solution. There let plates remain until all are developed: or, if the tank will not hold all, call a halt when the fixing-bath is full, have full white light and transfer plates to the washing-tank, afterward well rinsing the hands before going on with development.

Finger Markings

One insidious cause of dark patches on negatives is transference of finger markings from the back of one plate to the film of another, as may readily occur when a number of plates are stood against one another for a time in the darkroom whilst the lot is being developed.

Even markings from moist fingers will cause bad patches in this way and if the backs of the negatives have been touched by hypo-tainted fingers the result is worse still. It should be made a rule never to lay the surface of an exposed plate in contact with anything except the surface of another exposed plate. That again is a precaution which would rule out a whole troop of everyday failures.

Reddish Patches

These are most commonly due to incomplete fixation and as a rule do not show in their full depth until some time after the negative has been dried and exposed to light. They become worse as time goes on.

In the case of roll or cut film, fixed in a dish, it is easy for part of a negative to escape fixation by floating above the surface of the bath or by another film pressing on it. Care requires to be taken to keep negatives under the solution, for which purpose there is nothing

so useful as the ebonite Eastman print paddle since it saves one's fingers from all contact with hypo. But with all care, single film negatives are liable to come to harm in a fixing-tray: it is far better to carry out fixation in a deep earthenware pot as already suggested on an earlier page of this number.

Clear Patches The image may be altogether missing from parts of the negative, these portions being practically clear glass.

This defect takes at times very puzzling forms, but it is clear that it must be due to local non-action of light from some cause or other.

Where the blank parts occur on the edges or in the corners of a negative, the cause most probably is either want of covering power in the lens or cut-off of light from the lens by the bellows, etc.

The Lens Does Not Cover Lenses differ greatly in respect to covering power. Some will cover a plate considerably larger than that for which they are listed. With others, the larger plate is covered "in a way," that is, the image extends to the larger area but is of poor definition. In optical language, the larger plate is "illuminated" but not "covered." With still other lenses, among them some of the finest, a plate which is very little larger than that listed for, is not evenly illuminated. It is a lens of this class which may easily cause clear corner spaces on a negative, if the rising front of the camera is used or if the lens is of somewhat short focus in relation to the plate used in the particular case.

The Bellows Cuts Light Off Cut-off by the bellows is usually most marked at the corners or over the foreground part of the negative. The latter is due to the bellows sagging and cutting off rays from the lens passing to the top part of the plate. This is most liable to occur when the camera is used with the bellows fully extended, since there is then more tendency for the bellows to droop.

Remedies One preventive is to stiffen the bellows by varnishing the outside with shellac varnish or by gluing some black stiffening material inside. Better than either of these to fix

a pair of loops (one each side) about midway along the outside of the bellows. By means of an elastic band slipped through each loop and then hitched to the lens front, the bellows is pulled forward and ceases to foul the path of rays from the lens. Many cameras now have this fitment.

It is easy to tell whether the bellows is causing cut-off. Remove the focusing-screen from its frame, rack out the camera to the normal extension and point it to a clear sky. Then, with the lens open, carefully place the eye in each corner of the screen-frame in turn. You should be able to see practically the full disk of the lens-aperture. If this is not visible, it is clear that the bellows is cutting off.

A taper bellows is particularly liable to cut-off when a wide-angle lens is being used at the same time that the front of the camera is considerably raised. But the trouble is sometimes due to misuse of the movements of the camera. In raising the lens, the fullest use should be made of all rise of the lens-panel before raising the front to which the bellows is attached. With some cameras it is well to have an extra panel (with flange) for the wide-angle lens, fitting the flange high on the panel. The small size of wide-angle lenses allows of this being done and the extra panel saves raising the bellows so far.

Faulty Shutter

Bare, clear portions of the negative in the corners or round the edges may likewise be caused by a shutter, placed behind the lens, cutting off marginal rays from the lens. A roller-blind shutter, which formerly was fitted behind many lenses, is the pattern which by its bulk is most liable to have this effect. Any cut-off action can be discovered by the method just described.

The Lens Was Obstructed

Fairly clear patches of strange shapes and often covering a good part of the plate are due to some dark near object coming before the lens at the time of exposure. A finger placed before the lens at the opening of the shutter, or the branch of a tree, may thus spoil a negative from a viewpoint which has been carefully chosen through foliage or a corner of the focusing-cloth may

slip down in front of the lens. The patches are, in fact, the very much out-of-focus and under-exposed images of these intruders.

A peculiar instance of this kind of thing was recorded some years ago by a careful worker who found negatives every once in a while defaced by extra-clear markings. The trouble was traced to the roller-blind lens-shutter or rather to the tassel on the end of the cord serving to set the shutter. On the shutter being released this tassel would sometimes be flicked right in front of the lens, at sufficient distance from it to function as a very near dark object at the instant of exposure. The unconscious interposition of a finger before the open lens at the moment of releasing the shutter or taking off the lens cap is, however, the most fruitful cause of this trouble which bothers beginners in particular.

Clear Fine Lines When these appear on glass negatives they may be caused by heavy-handed use of a coarse brush in dusting plates. I have already advised as to the best way of removing possible dust from plates before exposure.

With roll film, pressure of the film surface against a chance particle of dirt may cause a white line although defects of this sort are very rarely met with in films as now manufactured. Fine lines running from end to end, often in great numbers, are a common fault in the use of film-packs. The remedy is to keep the camera interior absolutely free from all dust.

Dark Outline Marks This curious defect has cropped up with the introduction of tank development. It takes the form (in the negative) of a dark line or narrow band running along some outline in the subject where dark subjects come against a bright background, e. g., houses against the sky. The result in the print is a disfiguring white line.

The cause is local exhaustion of the comparatively weak developer used in a tank. For instance, the developer on the sky portion becomes exhausted whilst that on the house-roofs, does not, and diffuses over the line of the roofs, producing additional density all along the frontier between the two.

This can happen only when the developer remains

still, that is to say the real cause is omission to keep the developer in occasional movement during development. The best way of doing this with plate-tanks is turning the tank bottom up and *vice versa* three or four times during development. A good tank, e. g., the Eastman, should have a water-tight cover which allows of this being done.

The defect may arise in dish-development. That it does not do so as a rule is simply because plates in a dish are not left to themselves as those in a tank are liable to be: also because developing solutions used in dishes are usually of greater strength and therefore not exhausted by the development even of the heaviest densities in a negative.

Streamer Markings These are the same thing as dark outline marks but in a different form. They consist of bands of extra density running up (or down) from narrow dark objects on the negative such as chimneys, flagstaffs, telegraph poles.

The developer absorbed by the film in these parts of the image has relatively little to do and therefore tends to diffuse downward in the film. It thus produces a "streamer" of extra density if the position of the plate in the tank happens to be favorable to the effect, that is if there happens to be an area of fairly even density *below* the image of the dark object.

The preventive is the same as for outline marks: Keep the developing in constant, or at any rate in frequent movement.

Tangle Dark Markings These have a most mysterious appearance but a very simple cause. They consist of a tangle of (usually) a continuous dark wavy line or narrow band in the negative which sometimes may be largely covered.

The cause is a pinhole somewhere in the body of the hand-camera, usually in the bellows. As the camera is carried about in direct sunlight with the film or plate uncovered, this pinhole forms a series of images of the sun on the sensitive surface, the images joining together to produce a continuous band which crosses and recrosses upon itself as the camera chances to be pointed in various directions.

The remedy of course is to locate the pinhole and to close it, usually by a small patch on the inside of the camera bellows.

Mottling The appearance of a "regular unevenness" of density over (usually) the whole of the negative. By "regular unevenness" I mean a species of pattern which is generally like that of crocodile leather or the ripple-formation of a sandy beach at low tide.

One cause is omission to keep the solution in movement during development. Pyro, pyro-metol and hydro-quinone are more liable to cause mottling if left stagnant on the plate than are other developers.

Another cause is incomplete fixing from taking the plate too soon out of the hypo-bath. Most likely to occur if the fixer is greatly exhausted or unduly cold.

If the hypo bath is the cause the plate will almost certainly show also brownish stains; if not at the same time, inevitably before long.

Reticulation This defect somewhat resembles mottling in appearance but is much finer and more sharply defined. It consists of a minute pattern extending over the whole surface of the negative in the shape of a granular structure.

It shows more in the heavier densities of the negative but is really uniform over the whole film.

The cause is sudden swelling of the gelatine due to removal of the negative from one bath to another at much higher temperature or from a solution which hardens the gelatine to one which softens it.

A common cause of it is the mercury-ammonia intensifier. The mercury bath hardens the film and the ammonia solution softens it. Hence the film is caused to wrinkle itself up to the complete ruin of the negative. Transference from cold to much warmer water will have a similar effect.

Frilling This common defect in plate negatives is a partial separation of the emulsion film from its support. It occurs at the edges extending inward for a greater or less distance. The better grades of plates in the markets are now almost completely free from any

liability to frilling when handled with reasonable care.

The predisposing cause is chiefly sudden change of temperature by transferring the negative from a bath of ordinary to one of considerably higher temperature, or *vice versa*, but any tendency to the defect is aggravated by the use of a strongly alkaline developer (one made up with caustic soda or caustic potash), by too strong a hypo bath; by transference without intermediate washing from an alkaline developer to an "acid" fixer, by handling the edges of the plates unnecessarily with warm fingers and by washing plates so that water from the faucet or a spray strikes them edgewise.

If a modern plate shows a tendency to frill, it is best to use the amidol (diamidophenal) developer on account of its freedom from alkali. That, coupled with the use of an alum-hypo fixer, will usually suffice to avoid the defect completely, but if it does not, pass the negative after development straight into a bath of formaline of strength 1 part mixed with 20 parts of water, afterward rinsing for five or ten minutes before fixing.

This formaline bath may even be used before development if it is necessary, likewise washing the plates for a few minutes before proceeding to develop.

Blisters

These are simply another form of frilling, also very seldom met with now. They are usually in the form of minute bubbles anywhere in the film and are caused by the same general faults of manipulations which occasion frilling, more particularly laying warm fingers flat in the film or exposing the surface of the negative to the force of water from the faucet or rose-jet.

Leathery Markings

These are rarely met with now in ordinary working conditions, due perhaps to more perfect emulsions, but chiefly to the abandonment of the alum bath immediately after development, as was often necessary in the old days in order to keep the film on the glass.

The markings occur as mottled dirty leathery looking patches which no amount of washing or soaking will remove. They arise from the use of the alum bath after development, chiefly, from the too great strength of

this bath or from it having become charged with alkali from the developer.

Except under extreme tropical conditions there is now no necessity to use an alum bath before fixing. If such preventive of frilling is necessary, it is better to use formaline instead of alum, or to keep all baths at a uniform moderate temperature with ice, supplemented by an alum-hypo fixing-bath.

But a further caution is needed here, as exhausted fixer containing both hypo and alum is liable to give rise to these leathery marks for which, from whatever particular use of alum they arise, there is no remedy.

Rotting of Films

While upon the subject of alum I would mention a defect which appears to be connected with it. This is the rotting of the entire gelatine film in the course of years. I have seen it with negatives, both varnished and unvarnished, and with those kept under proper conditions of dryness and moderate temperature.

It is a defect which is not likely to come in evidence in less than ten or twenty years but nevertheless I have known cases where its consequences were a very serious matter for the owner of the negatives.

In one, some hundreds of negatives of paintings, many of them made in foreign galleries, were ruined in this way, the films having become as rotten as tinder and many of them separated from the glass. In every instance the alum bath had been used before fixing, as was the custom years ago, so that there seems some reason for vetoing the use of alum in any form in the making of negatives, if permanence is important.

Printed Matter on Negatives

If plates are packed with newspaper or other printed matter in contact with the film for any great number of hours, the lettering will appear in the negative on development as the result of fogging action by the ink.

Exposed plates should be packed film in contact with film, two or three pairs of plates being wrapped in one parcel in this way, and the parcel bound firmly with a gummed paper, e. g., some passe-partout binder. The object of this is to prevent plates rubbing on each other and doing each other mechanical damage.

There is no means of removing these markings. I have seen it suggested that short contact with newspaper results simply in transference of the actual ink of the printing to the emulsion and that in that case rubbing with benzole on a wad of absorbent cotton and even with the wet finger will remove them. This may be so, but I have never met the defect in a form which yielded to this remedy and am inclined to doubt its existence except in the textbooks.

Wood Markings

I referred on a previous page to the fogging action which certain fresh woods may have on plates. It should be said that it may (rarely) happen that the pattern or texture of the wood of the shutter of the plate-holder or dark-slide may impress itself on a plate kept in them under conditions favorable to the action, viz., warmth and moisture.

The preventive of recurrence of the disaster is to paint the wood with solution of potass. permanganate.

Dark Scratch Markings

These are similarly liable to occur as the result of fresh scratches on the aluminum draw-shutter of a plate-holder. The cause of the action in the cases alike of printing ink, wood or metal is formation of minute traces of hydrogen peroxide.

The remedy suitable for a metal shutter is to paint the surface with platinum bichloride solution.

Crystalline Surface of Negative

This is due to hypo fixing salt left in the gelatine film through insufficient washing: and the washing must have been simply forgotten altogether or done in the most perfunctory way for this defect to occur.

The point of fact, immersion of a negative in running water for not more than ten minutes will wash out 90 per cent of the hypo in it. The remainder left in is not enough to show as a crystalline film on the plate.

Therefore this defect points to some pure forgetfulness rather than to faulty manipulation. Still I may remind the beginner that constant change of water is necessary for the removal of hypo, i. e., either a running stream or the handing out of negatives from one dish (or tank) of clean water to another.

Half an hour's such washing will clear hypo from a negative fully. If negatives are fully fixed, longer washing—if it is of this kind—does no good. By "fully fixed," I mean that negatives remain in the fixer for as long again as is required for the white emulsion to disappear.

A negative which is found to be crystalline can be put to wash and often will be found to be as perfect as one washed properly in the first instance. At times, however, a negative which has this experience is left defaced by patchy markings.

Double Exposures The making of two pictures, mixed together in a single negative is a mistake which happens to all of us once in a while, most easily, I think, in the use of double plate-holders.

With roll-film or film-pack cameras or changing-boxes it is only necessary to accustom oneself to bring a fresh length of film or another plate into position as soon as the preceding exposure has been made. Let that be a fixed rule and you will get no double exposures.

With plate-holders it is different. The preventives consist in various means for locking the shutter once it has been thrust home or for boldly advertising the fact that it has been out and in again.

For the former, a homely plan is to stick down the lower end of the shutter to the body of the holder with a bit of gummed paper-edging. The same object is served by various patterns of automatic catch sold for fitting to plate-holders. As first set when loading the holders, these allow of the shutter being withdrawn, but on the shutter being returned, the catch holds it and prevents it from being again raised unless one deliberately releases it. The Dallmeyer "Auto-catch" is one such device.

Indicators take the form of a small panel hinged to the upper end of the plate-holder and caused to spring upright (on the shutter of the holder being withdrawn), disclosing the word "Exposed." For the pull-out shutters, customary with American holders, the better plan is to have one side of the shutter a distinctive color or to have one boldly marked "Exposed."

Reversal of Negative

At times the plate or film on development will show not as a negative but as a positive, usually a much veiled or fogged positive. Sometimes part only of the negative will be reversed in this way.

Great over-exposure may be the cause of this reversal, e. g., several hundred times the correct exposure, but I think very few cases arise in this way. The most frequent cause is excessive exposure to the darkroom light of an under-exposed negative during development.

It is easy to see how a positive can be formed. An under-exposure being slow in appearing and still slower in reaching proper strength, the beginner is tempted to hold it up frequently close against the darkroom lamp. No ordinary lamp is without some action on fast emulsion in these conditions, hence it may happen that a printing action takes place through the negative just developed upon the undeveloped emulsion below. Thus a positive is printed, proceeds to develop and may reach a strength sufficient to overpower the negative of the original exposure.

My experience is that reversal is not a very uncommon defect with film and when development is done in a dish. It is with film I have chiefly met it, though there is no reason why it should not occur with plates.

Physical Damage

This usually happens in the way of scratches, pieces dislodged from the film, may be referred to here although its avoidance is almost entirely a matter of ordinary care in manipulation.

With roll-film one of the most prolific causes of this damage is the practice of cutting up the band of film and handling the pieces together in the developing- or fixing-tray. The sharp corners of each piece are then very liable to dig holes in other pieces. A partial preventive is to give each corner a rounded shape by snipping it off with a pair of curved nail scissors; but I advise every user of film to develop it in the piece, using either the kodak or other tank or getting a long dish made to accommodate the fully extended band. See-sawing the length of film up and down in an ordinary tray is too arm-aching a job and moreover is liable to

lead to fog or stain, the one from exposure of the film to the darkroom light and the other to exposure of the thin film of developer all the time to air.

The other chief cause of damage to film negatives is in drying. Neither side of the film should come in contact with anything but must be pinned up free of the support. Here again it is much easier to arrange matters satisfactorily when one has only uncut bands to deal with: the single negatives also curl much more in drying.

Damage to glass negatives is likely to arise from letting plates slide over each other when re-packed after exposure, to allowing one to slip over another in the developing-tray or to carelessness in inserting them in grooved tanks or drying-racks. On this last point let me advise the beginner to make a habit of placing plates in any grooved apparatus always with the film side facing in the same direction, i. e., to right or left. As a plate is generally held by the right hand, it is best to place it with the film facing to the left. Then when you insert the next negative, you have the glass side of No. 1 toward you and can't possibly damage its film by poking a corner of No. 2 into it.

Absence of Image

Perhaps the beginner who has scanned these pages in the aim of forearming himself against the failures which they depict may feel almost a sensation of relief when he comes to this paragraph. He may exclaim:—"at any rate if I get nothing on the negative, I am spared anything being the matter with it"—a view in which I entirely concur.

But let me say again that I have sought to make my list of failures as complete as I can, a "cautionary list" of photographic undesirables to instance a publication by the English newspaper, "Truth", locating the human pests of society who prey upon the guileless. I name and describe in order that they may be avoided, but I cannot imagine any of my readers so unlucky as to experience any number of them at one and the same time.

However, to return to our last failure among negatives—that of nothing on the plate or film. Clearly it

can arise from several various mistakes. With plates, the shutter of the holder may not have been withdrawn or a backed plate may have been put in the holder, backing side toward the lens.

With any sensitive material the shutter may not have operated, or by mistake a small stop may have been used for a rapid shutter exposure. Box cameras of a kind which may be called "contraptions" are the most open to suspicion as regards causing blank "negatives." With some in which plates or cut films (in sheaths) fall by their own weight after exposure, a sheath may block the way from the lens. I once had a box camera bearing an eminent name which would rarely expose more than two or three of the thirty cut films it contained.

Or again the developer may be compounded wrongly by omission to add such essential chemical as the alkali.

It may be taken for granted that no sensitive material ever gets to the market, which, given some kind of exposure and developer, will not yield a negative. Plates and films have their defects at times—remarkably few—but I never heard of material which was incapable of giving a developable image. In my own experience, let me candidly confess, this failure has usually resulted from the simplest and surest cause, to wit: I neglected to open the exposure shutter or to draw out the slide of my plate-holder. *Verb. sap.*

A Friendly Competition

Bringing our discussion of "Failures—and Why" to an ending here, I propose a friendly competition which may serve to give practical point to what has been here recited in detail. The terms of the competition are simple. Let the reader send in to the Editor of The Photo-Miniature a print showing his worst failure in negative-making, with a plain, unvarnished account of the "why and wherefore" of the failure. To the most interesting "failure—and why" received before the end of 1916 a consolation prize of $5 in gold will be awarded December 30, 1916. For every "failure—and why," i. e., print and explanation received during the year *and considered worthy of publication*, $1 will be paid promptly on receipt, or the exhibit will be returned to

the sender. Intentional failures will, of course, not be eligible in this competition and the good faith of the competitor must be evident in his "failure and why." Similarly any "failure and why" described in this number of The Photo-Miniature is ineligible.

Second International Photographic Exposition

Preparations for the Second Annual Exposition of Photographic Arts and Industries, to be held at Cleveland during the week beginning March 6, in connection with the Fourth Annual Convention of the Photographic Dealers' Association of America, are going forward, and the management says that already they are assured of sufficient support to make the Exposition the most successful event of its kind yet held in America.

The President of The Photographic Dealers' Association of America is Mr. H. M. Fowler of the Fowler & Slater Co., Cleveland, Ohio, and the Secretary is Mr. A. H. Chilcote of the Chilcote-Sargent Photo Supply Co., Cleveland, Ohio, either of which gentlemen will gladly answer any inquiries concerning the Exhibition.

The exhibit of photographs, which will form a prominent feature of the Exposition, should interest our readers in a special way. Full particulars of the prizes, rules and regulations of this exhibition can be had on inquiry to the Print Committee, International Exposition of Photographic Arts, 241 Engineers Building, Cleveland, Ohio.

The principal manufacturers and importers of photographic apparatus and supplies have already arranged for exhibits and demonstrations of their products at the Exposition, which means that the visitor will have an opportunity to get a first-hand acquaintance with whatever is new and desirable in photography up to date. The fact that the Exposition will be held in conjunction with the Annual American Women's Exposition, at which there is usually an attendance of over 150,000 people, guarantees that the Exposition will attract a larger body of the public than has ever been gathered together before for an event of its kind.

Among the exhibits of special interest will be a demonstration booth showing the practical possibilities of the Imp Flashlight Gun recently introduced by the Imperial Brass Mfg. Co., Chicago. The Imp Gun has created a sensation among amateurs by its remarkable simplicity and efficiency, making the most difficult subjects as easy by flashlight as by daylight. Its convenience renders it as useful out-of-doors with the hand camera as indoors with a camera on the stand; for combination indoor and outdoor pictures; special lightings of athletic "stunts" where the light does not permit of the short exposures necessary, and similar subjects. These and other applications will be demonstrated daily at the Exposition.

We trust that every one of our readers within a radius of five hundred miles of Cleveland will make an effort to send examples of their work for the print competitions and attend the Exposition, in order to share in the many advantages it offers.

Notes and Comment

Editor Brown, of "The British Journal of Photography," writes me that "The British Journal of Photography Almanac" for 1916 is now in the hands of the binders, and should be ready for delivery in America about the middle of February. "About as fat as ever, and I think more interesting than ever before," is his brief comment on the new volume, which has occupied most of the last three months in its making. The B. J. Almanac is "the one thing necessary" after the THE PHOTO-MINIATURE and like the P.-M., quickly sells out and is difficult to get when once sold out. Order a copy from your dealer today. George Murphy, Inc., New York, is the sole sales agent, but any dealer can supply.

I am glad to hear of the instantaneous success of "Snow White," the one and only really satisfactory white water-color fluid yet introduced to a long-suffering world. "Snow White" has won the endorsement of the best workers in the profession. Mr. Pirie MacDonald, of New York, says it is better than anything he ever used. A dealer tells me that his amateur customers bought out his supply in a few days, finding it "just what they wanted" for titling prints and marking details in albums, etc. Send 25 cents for a sample jar, to J. W. Johnston, Box 578, Rochester, N. Y., and try it out with pen, art brush or air-brush, and you will bless me for the suggestion.

One hears tales of every sort of woe concerning shortages in the supply of photographic chemicals and imported specialties generally. But in truth there does not seem real cause for any worry. The average dealer can still supply most of the items the average photographer, amateur or professional, calls for; and the

majority of dealers report business "brisk and improving." A good rule for the individual buyer is to "Buy advertised goods." If a thing is advertised one may be fairly sure that there is no shortage in supply. More important, if a thing is advertised, one may be sure it is good value. Nothing but the best can be advertised today.

A very complete and interesting account of "The Making of a Photographic Objective," being a description of a course in applied optics offered at the Emerson MacMillin Observatory of the Ohio State University, Columbus, Ohio, by H. C. Lord, comes to my desk. As far as I know, this is the only available account of how lenses are made, at present available. The descriptive work is very well done and the illustrations add to the interest of the text. No price is given, but, doubtless, copies can be obtained from the author, addressed as above.

The 1916 Pittsburgh Salon of Photographic Art, under the auspices of the Photographic Section of the Academy of Science and Art, will be held in the Art Galleries of the Carnegie Institute, Pittsburgh, March 2 to March 31. All pictorial workers are cordially invited to contribute. No picture will be eligible that has been exhibited heretofore in the United States. The aim of the Salon is to exhibit that class of work in pictorial photography in which there is distinct evidence of personal artistic feeling and execution. Copies of the prospectus giving the conditions for the receiving of exhibits and entry blanks can be obtained from the Secretary, Mr. C. E. Beeson, 1900 Frick Building, Pittsburgh, Pa. The last day for receiving prints is Wednesday, February 10. Prints may be sent unframed.

No. 3 of the "Practical Photography" Series, published by the American Photographic Publishing Co.,

Boston, Mass., is entitled "How to Choose and Use a Lens." A careful reading convinces me that this is one of the most complete as well as the most satisfactory handbooks to the choice and use of photographic lenses which has yet appeared in the language. The man who will make himself familiar with the information given in the 83 pages of this handbook, together with The Photo-Miniature No. 140 *Lens Facts You Should Know*, will know about all he can or should know about the subject, at a cost of half a dollar. The price of the "Practical Photography" handbooks is, paper covers, 25 cents; cloth bound, 50 cents.

For home portraiture, whether professional or amateur, and for the photographing of groups at banquets, weddings and similar occasions, no illuminant has been found to equal the flashlight when properly handled and controlled. The simultaneous ignition of several charges with the opening of the exposure shutter, and the absence of flash and smoke, are the prime difficulties in this work. These difficulties are completely overcome by the use of a thoroughly reliable ignition system connected with flash bags. The most satisfactory flash bags within my knowledge are the Victor Portable Flash Bags, made by James H. Smith & Sons Co., 3535 Cottage Grove Avenue, Chicago. Readers who are interested in these branches of work would do well to give the Victor bag a practical test.

Beginning with January, 1916, "Popular Photography" and "The Photographic Times" are to be merged, and the combined magazine will appear under the title of "Popular Photography." "The Photographic Times" is the second oldest photographic magazine published in the United States, and its union with "Popular Photography" should make a strong and interesting magazine. (The American Photographic Publishing Co., Boston, Mass., subscription $1 per year.)

One of the most remarkable subscription offers yet made in the way of photographic literature is that published in the photographic magazines by "The Camera," 208 North 13th Street, Philadelphia. According to the terms of this offer, any amateur photographer can secure "The Library of Amateur Photography" in four volumes, containing 1,620 pages of photographic information and originally sold at $10, absolutely free by sending $4.50 for a three-year's subscription to "The Camera," or $2.50 for one year's subscription to "The Camera."

This "Library" was prepared by a number of photographic experts and published by the American Photographic Text-Book Co., of Scranton, which is now in the hands of a receiver, by which misfortune this offer is possible. I have used this "Library" frequently during the last few years, and have found it a veritable mine of photographic information. No reader of THE PHOTO-MINIATURE should miss the opportunity.

Motion-Picture Making and Exhibiting. A comprehensive volume treating the principles of motography: the making of motion pictures, the scenario, the motion-picture theater, the projector, the conduct of film exhibiting, methods of coloring films, talking pictures, etc. By John B. Rathbun. 236 pages, illustrated. Cloth. 1914. price $1.10, postfree. Tennant and Ward, New York.

This is an attempt to present the technics of motion-picture making and exhibiting within the compass of a small volume, and yet give the reader practical working details and diagrams covering the field. The author has had a wide and varied experience in motion-picture work and his exposition of the subject is marked by his practical experience in the different stages of the methods described.

The American Annual of Photography, 1916, Vol. XXX. Edited by Percy Y. Howe. 328 pages, 200 illustrations, including 32 plates in color. Paper covers,

75 cents, postage 15 cents; cloth bound, $1.25, postage 20 cents. Sole trade agents: George Murphy, Inc., New York.

In spite of the interferences and distractions due to the great war, Mr. Howe has managed to gather into his Annual an assortment of practical papers and attractive illustrations quite equal, in interest and attractiveness, to those given in previous volumes. The book opens with an account of the "Kodachrome Process of Color Portraiture," by Dr. C. E. Kenneth Mees, which is but one of several articles dealing with the all-absorbing color interest in photography today. There is the usual assortment of illustrated papers dealing with photography and travel, photographing birds and animals, and a particularly interesting paper on "High Speed Flashlight Photography" by Wm. Nesbit, who has given special attention to this field of work. Altogether the Annual is a worthy successor to the volumes that have gone before and should be indispensable to those who want to keep abreast of what is being done in photography at home and abroad.

The Appeal of the Picture. An examination of the principles of picture-making. By F. C. Tilney. London, 1916. As these pages go to press I am advised of the publication of this book by J. M. Dent & Co., of London. Because of Mr. Tilney's wide knowledge of pictorial photography and his ability to teach, I am confident that his new volume will afford pleasure and help to many who are puzzled by the questions: What makes the picture? How can I make pictures instead of photographs? and so on. A detailed notice of the book will appear in these pages as soon as I can lay hands on a copy.

An unheralded exhibition of pictorial photographs was held at the Print Gallery, 707 Fifth Avenue, New York, during December. In their foreword to the catalogue, the judges, H. W. Kent, of the Metropolitan Museum of Art, Dr. F. Weitenkampf, of the New York

Public Library, and Albert Sterner, painter, state that in selecting the 77 pictures shown out of the 200 submitted, they avoided technical points and estimated the value of the work simply on its artistic merits. This is certainly a new viewpoint from which to look at an exhibition of photographs. Some of the pictorialists whose work passed this judgment were Arnold Genthe, Angelo Romano, Karl Struss, Roger B. Whitman, George S. Seeley, and D. A. Davis.

The Art of the Moving Picture, by Vachel Lindsay, just published by the Macmillan Co., New York, is a monograph which deals with the art side of the motion picture, discussing the different kinds of photo-plays, the resemblance between the moving picture and the picture sculpture found in Egypt, and making a comparison between the legitimate stage drama and the film play. It does not contain much of interest to the photographic reader.

1001 Places to Sell Manuscripts. Edited by Wm. R. Kane. Cloth. $1.62, postpaid. The Editor Co., Ridgwood, N. J.

The photographer who seeks a market for his photographs or illustration material will find a veritable mine of profitable information in this volume. Although designed chiefly for the writer of stories and photoplays, it gives lists of illustrated magazines, technical periodicals, book publishers, film and postcard manufacturers, and a special department is devoted to the market for photographic prints. I know of no other volume which so completely fills the requirements of the photographic illustrator, except THE PHOTO-MINIATURE, No. 120: *Marketing Photographs for Publication*.

In the February number of the "Photo-Era" (15 cents, Boston, Mass.), Mr. Franklin H. Smith publishes a very helpful paper on "Speed and Exposure Tables

for the 3A Kodak." The paper is illustrated with four diagrams, and should be particularly useful to the owners of the 3A Kodak.

How to Make Prints in Colors. Edited by Frank R. Fraprie. 66 pages. Paper, 25 cents; cloth bound, 50 cents. The American Photographic Publishing Co., Boston.

This is No. 4 of the "Practical Photography" series. It gathers together in very convenient form most of the methods available by which one may produce prints in colors by photographic processes, including the blueprint, printing-out paper, home-made silver papers, toning gaslight prints, the carbon process, ozotype, gum bichromate, bromoil, with the Autochrome, Paget and Hicro methods of direct color photography.

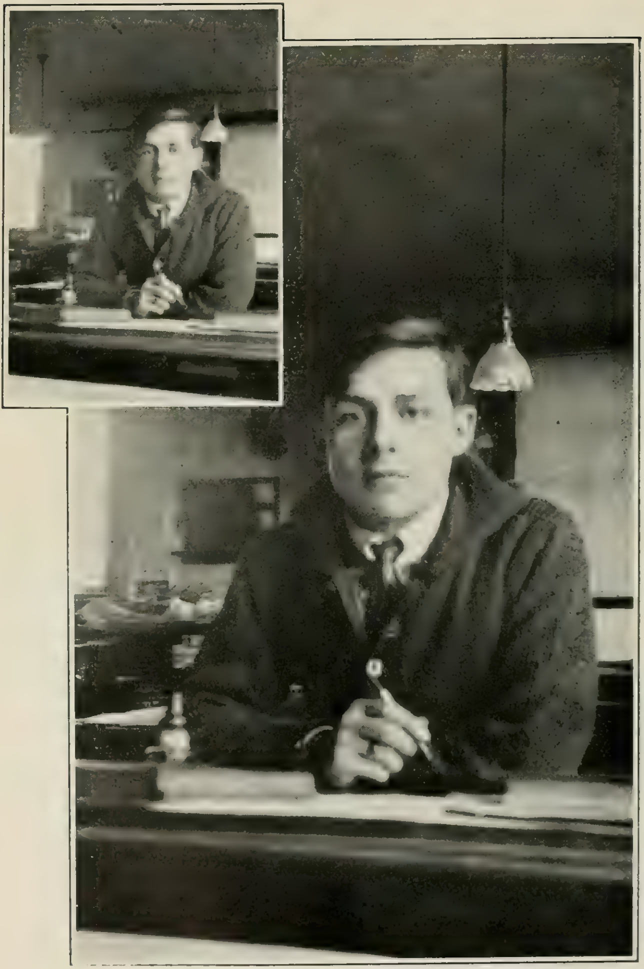
Window-lighted portrait of Mr. Charles F. Rice; contact print 1 x 1 5/8 and enlargement 5 x 7, the original being made with a motion-picture lens, Zeiss-Tessar $f/3.5$, 2 inches focal length. Exposure one twenty-fifth second on Marion Record plate. Enlargement on Enlarging Cyko.

"General X"

Reproduced from a 5 x 7 print on gaslight paper from an enlarged negative made from a portion of a 2¼ x 2¼ film negative. In making the enlarged negative the original background of picket fence and buildings was removed and the tents, hills etc., drawn in on the glass side of the positive — as referred to in the text. Maker of original negative unknown.

A home group, from a 5 x 7 enlargement of a portion of a 2¼ x 3¼ film negative; 3-inch Zeiss Tessar lens; exposure 15 seconds, at $f/4.5$. No illumination used other than the lamp shown in the picture.

Charles. F. Rice



School portrait made with the V. P. Kodak and 3-inch Kodak Anastigmat *f*/7.7, enlarged to postcard size with the Kodak fixed-focus enlarger. The definition of the face would have been better if the advice given in the text, to "err on the near side" in focusing had been followed.

K. J. Van Sickle

Contact print 1¼ x 2½ and enlargement 3½ x 5½, made with V. P. Kodak, Kodak Anastigmat and Kodak fixed-focus enlarger. Note the wonderful depth of definition in near and far objects.

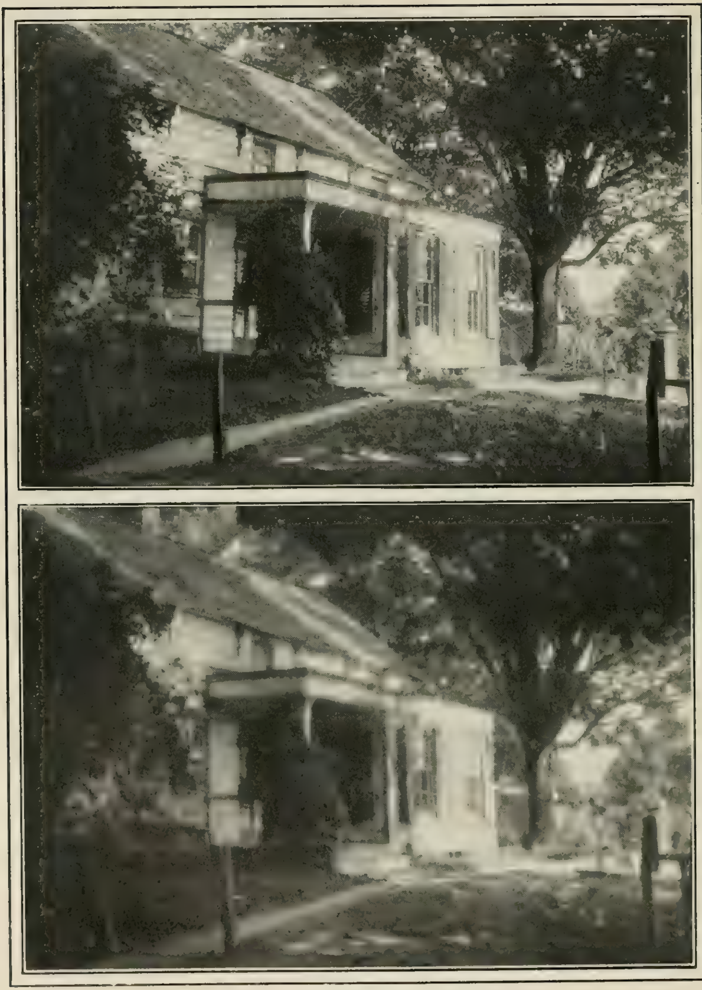
K. J. Van Sickle

Church interior with Easter decorations. Reproduced from a 5 x 7 enlargement on Enlarging Cyko, made from a 3¼ x 4¼ negative; 3-inch Goerz Dagor lens; exposure 10 minutes at *f*/16. Note the wide angle and depth of definition.

Contact print 2 x 2[illegible] and 8 x 10 enlargement, from roll-film negative, 3-inch Zeiss Tessar lens, exposure one-twenty-fifth second, camera held in hand. Enlargement made on Normal Cyko.

This enlargement would pass for a good contact print from an 8 x 10 negative. The detail definition is unusually fine, the figures farthest away from the camera being as sharp as those in the front. This would not be so in an 8 x 10 negative unless a much smaller stop than that here used (F/8) had been employed.

Newsboys. By Charles F. Rice



Sharp and diffused focus enlargements from portions of 2¼ x 2¼ roll-film negative; 3-inch Zeiss-Tessar lens, *f*/4.5. Exposure, one-twenty-fifth second. From 5 x 7 enlargements. The diffused focus effect in the lower print was obtained by the use of a semi-achromatic lens in enlarging.

Charles F. Rice

The Photo-Miniature

A Magazine of Photographic Information

EDITED BY JOHN A. TENNANT

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Success with the Pocket Camera

This is the day of the little camera.

We have learned that whatever is small is not necessarily insignificant nor inefficient. Goliath, you will recall, lost his life some years ago because he failed to recognize a worthy antagonist in the stripling David.

In 1909, the Editor of THE PHOTO-MINIATURE said: "The phrase 'photography with small cameras' covers the most interesting movement in photography since the advent of the anastigmat. This movement is the widespread introduction of very small cameras of high efficiency."

Now I will go further. The little camera of high efficiency is not only an interesting and significant development, but really much more than that. It bids fair to revolutionize the practice of photography. But because we, Goliath-like, have not perceived the full capabilities of the short-focus anastigmat lens, that most efficient little instrument is only slowly coming into its own. The idea persists that the miniature camera is a toy because in many hands it has been used as a toy, and not as the finely adjusted instrument of precision that it is. A bold attempt to bring this truth home to photographers was made in THE PHOTO-MINIATURE, No. 125: *Pocket-Camera Photography*, but, since the world was not wholly converted to the truth by that wonderful little book or its predecessor of 1909, I am here to tell the story again.

Consider the Motion Picture Motion-picture photography, that wonderful invention of the nineteenth century, has an important bearing on the subject of this handbook—for the modern, highly capable pocket camera may be said to be a by-product or outgrowth of motion-picture photography. In response to the need of the motion-picture camera, manufacturers evolved the anastigmat lens of short focus and large aperture—exactly the type of lens which gives the modern miniature camera its marvelous efficiency. And again in the motion-picture projection of a tiny image the size of a postage stamp to proportions that cover a 10-foot screen we are afforded a striking demonstration of the possibilities of photographic enlargement. Indeed, if we have eyes that see, we may learn much more from motion pictures in regard to the superiority of the short-focus anastigmat lens. We will see in motion pictures, for instance, that both near and distant objects are shown distinctly in the same view—denoting depth of focus. We will see also that such pictures, taken at the rate of sixteen per second, are often produced under most unfavorable illumination—denoting the use of a lens at large relative aperture, in other words a *fast* lens. These two most desirable lens qualities, depth and speed, we thus see are combined in the short-focus lens, whereas in the longer-focus lens more generally employed in everyday photography we obtain depth only by sacrificing speed, or we secure speed only at the cost of depth. Then at the front door of the motion-picture theater let us pause and examine the photographs on display, of selected scenes in the photoplay. These may be 8 x 10 enlargements direct from the original motion-picture negatives, and we shall see that the details are often as sharp and distinct as if they were contact prints from negatives produced by an 8 x 10 camera.

Details Overlooked What we don't see, but what is quite as important, is the nicely adjusted mechanism, aside from the lens, by which these wonderful results are accomplished—the smoothly working shutter; the focusing arrangement, graduated to a hair's breadth; the solid rigidity of

camera construction, so that no parts may wiggle or jiggle out of alignment; the tripod which supports the whole apparatus, so staunch and firm that there is no risk of tremor or vibration, and hence "fuzzy" pictures; and, above all, the care and skill employed in operating the apparatus. These things are mentioned to emphasize the fact that it is not "all in the lens," as some lens makers would argue.

Neglected Virtues Care and skill are not wasted in the operation of a one-dollar Brownie camera. They are even more essential to success with such a camera than with the modern pocket camera, which, though simple enough, is hardly to be considered a beginner's instrument, and is not so simple as to be altogether "fool-proof."

Comparisons Pocket cameras of a few years ago, at least so far as American models go, were not much more than toys. The lens was a single achromatic, working at *f*/16 or thereabouts, the camera usually of the "fixed-focus" form; the shutter a rotating disc, with one invariable "snap" of about one-fiftieth second; the whole apparatus cheaply made and not too carefully put together. This sort of camera is still with us. It is the kind that goes into the boy's stocking at Christmas time. It costs a dollar or two, and the limit of its capacity is a mid-day snapshot, —and it must be a bright day at that.

Compare with the foregoing the really high-class and highly efficient little camera of today, with its anastigmat lens working at *f*/4.5 or *f*/6.8, accurate focusing adjustment, highest type of between-lens shutter, giving exposures as quick as one three-hundredths second and, what is still more important, giving automatically the slow snap of one-tenth or one-fifteenth second; made of the best materials, durable and rigid in construction, and adjusted with that nicety of precision that characterizes the full-jeweled watch. The capability of this kind of camera is limited only by the skill of the man behind it. Any subject that can be photographed with the largest and most elaborately equipped "professional" outfit is quite within the scope of such a pocket-camera carefully handled.

"That Blessed Word!" Note that in this monograph the term "miniature" is applied only to the last described type of pocket camera—with large-aperture anastigmat lens, carefully adjusted focusing movement, and high-grade construction. Consider the miniature portrait, painted by the artist of ability and treated with as much care and skill as could be bestowed upon a monster canvas—perhaps more. Consider this, I repeat, and you will perceive the aptness of the word "miniature" as applied to the modern high-class pocket camera. You will also catch the distinction between the cheap fixed-focus pocket camera which is merely small, and the other type which, because of its concentrated excellence, combined with smallness, is truly a miniature camera.

Practical Advantages Some of the obvious advantages of all small cameras, whether of high or low degree, are their light weight, small size and convenience in handling. There may also be mentioned in this connection the fact that plates, films and paper cost less in small sizes. Because of these very evident advantages, the small camera of a generation ago was much used by travelers and explorers, and for memorandum purposes by those to whom a large camera would be burdensome. These little cameras, of which Shew's pocket quarter-plate of 1888 was a good example, produced remarkably good results—because they *were* small, and because the short-focus lens of whatever type has greater speed and depth than a long-focus lens of the same type. This was not fully realized until the introduction of the short-focus anastigmat, for that made possible the comparison of results from a 3-inch Goerz Dagor, for instance, with results from a 7-inch or a 14-inch Goerz Dagor—and such a test you may be sure is another republication of the David and Goliath story.

Results—the Test of Ability Results are what count. Suppose we have a certain view to photograph, and the ultimate result aimed at is the best possible 5 x 7 picture we can get. First, we use a 5 x 7 camera, and make a straight photograph in the regular way—a 5 x 7 negative and a 5 x 7 contact print from it.

Second, we employ a miniature camera, and get a 1¾ x 2½ negative of the desired view. From the little negative we make a 5 x 7 enlargement. Now compare the enlargement with the contact print. If the contact print is better, the big camera wins; if the enlargement is better, the little camera wins.

This sort of test I have made with many different kinds of subjects—landscapes, street scenes, portraits, interiors. And I tell you truly that, wherever depth and speed are important factors, the little camera wins. This is always providing that the conditions under which the two cameras are used are as nearly identical as possible—that they are equipped with the same type of lens, used at the same relative opening, with the same exposure, upon the same brand of plate, that the prints to be compared are made on the same sort of paper; and particularly that equal care is exercised in operating both cameras.

As I said before, the popular estimate of the efficiency of the modern pocket camera has suffered because people persist in using it as a toy. If used as carefully and in as capable hands as a large camera, the miniature camera will produce results not only "just as good," but better. Besides—and because of its very smallness and convenience in handling—many things may be done with the little camera that are either very inconvenient of accomplishment or entirely out of the question with large and bulky apparatus.

Don't Overlook This

Enlarging may be regarded as a necessary part of the process of picture-making with pocket cameras. I borrow herewith from an English writer, who says: "Every pocket-camera exposure is a hypothetical enlargement." A very apt phrase that. "Take it small, then enlarge," is the modern method of photography. No longer need the professional perspire under the load of a fifty-pound 8 x 10 outfit—unless, indeed, from perverse conservativeness, he prefers to do it that way. Instead, he may tuck a little camera under his arm or into his pocket, go blithely and unburdened about his day's picture-making, produce the desired 8x10 prints by enlargement, and get better results into the bargain.

Enlarging isn't what it used to be, either. Motion-picture photography has brought forth improved and simplified projection apparatus, which is adaptable to the purposes of photographic enlargement by artificial light. The electric arc, the nitrogen Mazda, the Cooper Hewitt mercury lamp, are all types of lamps recently made available for photographic purposes and especially for enlarging. The anastigmat lens shows its superiority as well in enlarging as in any other process of photography. Finally, bromide paper, which was for many years practically the only medium employed for enlarging, is being superseded by papers of the "gaslight" type, with a wide variety of capabilities, which produce bright, crisp enlargements from all sorts of negatives by careful choice of the paper used.

They Fit the Pocket

Pocket cameras are the subject of our consideration. Pockets, you will observe, vary greatly in size; so that in order to fit the watch-pocket a camera must needs be of very much smaller proportions than if it were designed for the largest pocket of a topcoat. One maker that I have in mind has made a fitting classification. His "vest-pocket" camera is for picutres 1¾ x 2½, while the "coat-pocket" size is 2¼ x 3¼. Let us limit our definition of pocket cameras, therefore, to those which take a picture not larger than 3¼ x 4¼—or perhaps, better, a picture whose longer dimension is less than four inches, and cameras the focal length of whose lenses is not greater than 3½ inches. Even within these limitations there is available a large and growing variety of apparatus—for, as we said at first, this is the day of the little camera.

European manufacturers took the lead in developing little cameras of high quality. Their goods found a ready market in this country, at prices far in advance of the home products—because, be it said to our discredit, our small cameras were hopelessly inferior to the imported models. This situation continued for several years, the European products gaining constantly increased sales in the American market, while our own manufacturers made little or no effort to evolve models which would compete with those coming from abroad.

Finally we woke up, and between the time of our awakening and the outbreak of the European war, a number of American pocket cameras were placed on the market which approached the excellence of the foreign-built apparatus. The latest American-made pocket camera, the Auto Fixt Focus (Herbert & Huesgen Co.), is a definite advance on all European models.

A Vital Matter

"Hyperfocal distance" is a term which bulks large in considering the subject we have in hand. This means the distance from the camera beyond half of which distance all objects will be in fairly sharp focus. It varies with the focal length of the lens and the stop employed. For instance, the hyper-focal distance for a 3-inch lens, at *f*/7, is 11 feet. If our camera were equipped with that lens focused on an object 11 feet distant, of course that particular object would be in sharpest focus, but all other objects both nearer and farther away that were at least 6 feet distant from the camera would be fairly sharp.

The following table gives, at a glance, the hyperfocal distances for lenses of different focal lengths with different stops, calculated on the basis of a disc of confusion of one-hundredth of an inch as the standard of sharpness of definition desired in the photograph.

Table of Distances on Which to Focus

with lenses of different lengths and different lens apertures (stops), so that all objects beyond half that distance will be in focus. Disc of confusion taken as one-hundredth of an inch.

Diaphragm Apertures: F Values and U.S. Numbers

Focus of Lens in Inches	F/4 U.S. 1	F/5.6 U.S. 2	F/6 U.S. 2.25	F/7 U.S. 3.06	F/8 U.S. 4	F/11.3 U.S. 8	F/16 U.S. 16	F/22 U.S. 32
	Distances in Feet							
2½	13	10	9	8	7	5	3½	3
3	19	14	13	11	10	7	5	3½
3½	25	18	17	15	13	9	7	4
4	34	24	22	19	17	12	8	6½
4¼	38	27	25	21	19	14	10	7
4½	42	30	28	24	21	15	11	8
4¾	47	34	32	27	24	17	12	9

Note that one-hundredth of an inch is stated as the "disc of confusion." This means a degree of unsharpness in the image which would allow a point or dot of inappreciable diameter to be in reality as much as one-hundredth of an inch in size. That is for the negative itself, or a contact print from it. If an enlargement is to be made, and it must be remembered that "every pocket-camera exposure is a hypothetical enlargement," then a smaller disc of confusion must be taken in calculating the hyperfocal distances, which would make such distances greater than in the table as it is given here.

Study this table of hyperfocal distances carefully. In it the discerning eye will see pretty much the whole story of pocket-camera efficiency. From the rows of figures you will be made to realize why fixed focus is allowable in the old-fashioned pocket cameras with a lens working at $f/16$ of perhaps 4 inches focus. The hyperfocal distance for this combination is 8 feet—so that, with the lens fixed at 8-foot focus, all objects more than 4 feet away from the camera will be reasonably sharp. This comes near accomplishing the mythical "universal focus," which used to be so frequently referred to in camera catalogs of a few years ago. Of course, there is no such thing.

Study the Table

You will see from a study of the table why the adaptation of large-aperture lenses to pocket-cameras makes necessary a focusing adjustment. A 3-inch lens at $f/8$ is about the limit for fixed focus, especially if the results are to be enlarged. If the lens is of longer focus than 3 inches, or works at a larger relative aperture than $f/8$, the camera should be fitted with a focusing adjustment. The table also shows why it is preferable not to exceed a focal length of 3½ inches in the choice of a lens of a pocket camera.

Choosing a Camera

In selecting a pocket camera, it should be considered who is going to use that camera—what his photographic experience has been. To be more personal—if you have no experience with cameras or if your practice has been limited to very simple apparatus, you should not choose the highest type of miniature camera, with $f/4.5$ lens,

focusing adjustment, one three-hundredths second shutter, film and plate adapters, movable front, etc. You wouldn't know what to do with such a camera—that is to say, you would not at first appreciate its fine points, nor be able to produce the best results of which the apparatus is capable. Begin with one of the inexpensive and simpler models.

The V. P. Kodak

One of the simplest and least-expensive pocket cameras that is really efficient is the Vest-Pocket Kodak with Kodak anastigmat lens. This little camera is of real vest-pocket dimensions. It makes pictures 1⅝ x 2½ on roll film, 8 exposures to the roll. The lens is of 3 inches focal length, works at *f*/7.7, and is of fixed focus. Not the least remarkable point about this camera is the price, which is only ten dollars.

You thought from what I said before that I wouldn't recommend any camera with fixed focus?

Look again at the table of hyperfocal distances, and you will see that this combination—3-inch lens at *f*/7.7 (practically *f*/8)—has sufficient depth so that, when the lens is fixed on the hyperfocal point, almost everything in front of the camera is in focus. If the lens were of longer focus or worked at a larger relative opening, it would be a different story.

The One Difficulty

Focusing is the bugbear and stumbling block of a large percentage of amateur photographers, so that it is a great blessing for many, and insures a much higher proportion of good results if the focusing is secured automatically. Some people never get beyond the fixed-focus stage of their photographic development, and should not be entrusted with a camera of adjustable focus. I have such a man in mind. He has been dabbling in photography for twenty-five years or more, yet it seems almost impossible for him accurately to estimate the distance of objects and set his focusing-scale accordingly—when he remembers to focus at all.

Begin with the Fixed Focus

Therefore, as a first investment and introduction to modern pocket-camera photography, I recommend a camera such as has been described; and with it a fixed-focus

enlarger. The enlarger yields prints of the popular post-card size, 3¼ x 5½. The quality of such prints, in the work of a beginner, is likely to excel the results that he would get if he started with a $20 3¼ x 5½ camera, and produced contact prints from the larger negatives. The Auto Fixt Focus camera is, of course, an exception to this rule, since with it the user makes it a "fixed focus" instrument by simply adjusting a device on the outside of the camera before opening it for use.

Limitations

What are the limitations of such a camera as the Vest-Pocket Kodak? We said of the old-style pocket camera that the limit of its capabilities was a midday snapshot. Its largest lens-opening is *f*/16, which allows just one-fourth as much light to pass in a given time as *f*/8. So our Vest-Pocket anastigmat at *f*/7.7 will do something more than a midday snap—it extends the field of our operations to earlier and later hours, and makes possible a snap or instantaneous exposure under light conditions that *f*/16 could not encompass. Further than that, the anastigmat at *f*/7.7, because it *is* an anastigmat, will give a picture sharp and distinct from corner to corner —not sharp merely in the center and inclined toward "fuzziness" around the edges, as is the case with the single lens at *f*/16 or a rectilinear at *f*/8.

More Comparisons

Let us take three distinct types of cameras and see how their limitations and possibilities are indicated with three different subjects:

Camera No. 1. Old-style pocket camera, such as the Kodak V. P. or No. 1 F. P. K., Ansco V. P., Ingento No. O, or Ensignette. Fixed-focus single lens, *f*/16, one instantaneous exposure of one-fiftieth second.

Camera No. 2. Vest-Pocket Kodak special, and the others of this type, with fixed-focus feature and an anastigmat lens, *f*/7.7, exposures one-twenty-fifth and one-fiftieth second.

Camera No. 3. Highest type miniature, focus adjustable to 3 or 4 feet distance, anastigmat lens, *f*/4.5, exposures any fraction of a second to one-three-hundredth. The Goerz V. P. Tenax and V. P. Speedex,

Ansco V. P. Speedex No. 3, the No. 1 Ensignette Special, and Ensignette de luxe No. 2, the Polygon V. P. and are all of this class.

Subject A. Open outdoor view at midday, bright sun. No objects nearer than 15 feet from the camera.

Subject B. Group of people outdoors, 12 to 15 feet away from camera, cloudy day.

Subject C. Outdoor portrait, subject 4 feet from camera, in deep shade.

The first subject, A, will be easily accomplished by all three cameras. Using camera No. 2, the lens might be stopped down a little to make the definition sharper in the extreme distance. With Camera No. 3, we would place the focus at infinity, use stop *f*/8 and give one-fiftieth second—or we can take advantage of the shutter's extra speed, if the view includes objects in rapid motion, by using one-three-hundredth second with the lens wide open, *f*/4.5.

Subject B cannot be satisfactorily negotiated by Camera No. 1, because the light will not allow of a sufficiently full exposure in one-fiftieth second at *f*/16. Even with sunlight, Camera No. 1 will hardly give satisfaction in group photographs if any of the figures are near the edge of the picture, because such outside figures will not be quite distinct. The best results, in dealing with a subject of this kind with Camera No. 1, will be secured by placing the camera on a tripod, using a small lens-stop, and giving a time exposure. Camera No. 2 makes this group nicely without any special precautions—lens wide open at *f*/7.7. Use a shutter speed of one-twenty-fifth rather than one-fiftieth, so as to give more ample exposure. Using Camera No. 3, we set the focus at 12 feet, and give one-twenty-fifth second at *f*/8; or, if we wish to bring out the figures sharp and clear against a slightly diffused background, we use the lens wide open at *f*/4.5, and give an exposure of one-fiftieth second.

Subject C eliminates Cameras 1 and 2, because they have no focusing adjustment. A supplementary lens, called a portrait attachment, will overcome that difficulty. But, the subject being in deep shade, neither of the first two cameras will give sufficient light action

with an instantaneous exposure. We could put either of these cameras on a tripod and, with the portrait attachment in place, give a short time exposure. With Camera No. 3, however, we need neither portrait attachment nor tripod. Set the focus at 4 feet, lens wide open at $f/4.5$, and—depending on the brightness of the light and the steadiness of your hand—give an exposure of one-tenth to one-twentieth second. (One-tenth second at $f/4{:}5$ will give 7 or 8 times as much light action as one-twenty-fifth second at $f/7.7$.)

Widening the Possibilities Do you not see, from these few illustrations, what great possibilities are opened up by such a pocket camera fitted with anastigmat lens and quick-acting shutter, over and above what could be accomplished with the pocket camera of a generation ago? You are not limited to "midday snapshots," and the anastigmat lens insures negatives that will yield enlargements of "contact" quality. In other words, you carry in your vest-pocket, ready for instant action, the equivalent of a postcard or even 5 x 7 camera.

Still greater possibilities are possessed, as we have indicated, by the pocket camera which has focusing adjustment, as many of the cameras in class 3 have, a lens working at $f/4.5$, and a shutter having a range which includes high speeds up to one-two-hundred and fiftieth or one-three-hundredth second and slow snaps of one-tenth to one-twentieth second. Of course, these cameras cost more than those of the simpler sort—many times more—but they are worth it. With a camera of this description you can get successful "snaps" at sunset or in dark, stormy weather, when the light may be not more than one-thirtieth as bright as in the middle of a sunny day. You can hold the camera in the hand and get portraits on a shady piazza, or even in a well-lighted room. The 3-inch lens has such remarkable depth that, even with so large an opening as $f/4.5$, you may be able to guess the distance near enough down to 3 or 4 feet—and this is something you can't do at $f/4.5$ with a 4½- or 5-inch lens. One-three-hundredth second is quick enough for any except extreme-speed work, and is not too short for ample light action with sunlight

and an $f/4.5$ lens. Add a pocket flash-lamp to this equipment, such as the Imp flashlight gun, and it gives one the ability literally to take "anything at any time."

Flashlight I have a friend who has taken many remarkable flashlight photographs with a miniature camera and a pocket flash-lamp—without tripod or any paraphernalia besides the camera and the lamp, which he carries in his pockets. He holds the camera in one hand, the lamp in the other. With the shutter on "bulb," everything being in readiness, he presses open the shutter with the thumb of the hand holding the camera, while with the other hand he sets off the flash. This requires a very steady hand and some knack. I have accomplished the trick myself, but not very satisfactorily. I mention it as an interesting possibility in pocket-camera work.

Use a Tripod There is no law against using a tripod with a pocket camera. You might think there was some such law from the way many amateurs shun the tripod. Of course, much more may be done by the pocket camera without a tripod than by a large, heavy camera, but there are many times when the tripod or some steady support is indispensable. There are such things as metal tripods that fold up compactly enough to go into the pocket, but they are likely not to be very rigid when extended. I should prefer one of those pocket clamps, with which the camera can be secured to a fence-rail or post or bicycle handle-bar. Don't forget, however, that what is needed is a support for the camera. Very often a chair or the top of any piece of furniture handy, or a convenient wall or rail, will serve all the purposes of the best of tripods when this is more convenient.

Which Pocket? Vest-pocket or coat-pocket? Which is to be preferred—the smaller instrument with 3-inch lens making a picture $1\frac{3}{4} \times 2\frac{1}{2}$ or thereabouts, or the larger camera with $3\frac{1}{2}$-inch lens making a picture $2\frac{1}{4} \times 3\frac{1}{4}$?

Mainly the difference between these two sizes is in the matters of lens capability and bulk of camera—and the difference is greater than might be supposed, especially as regards the lens. Refer, still again, to the table

of hyperfocal distances. There you will see that the 3-inch lens has as great depth at $f/5.6$ as the 3½-inch lens has at $f/8$. In other words, the 3½-inch lens is only half as fast as the 3-inch lens, if equal depth is required.

In parentheses, as it were, we might mention that the extreme depth apparent in motion pictures is accounted for by the fact that the motion-picture camera is usually fitted with a lens of 2 inches focal length, which has approximately four times the depth of the 3-inch lens at the same opening, or equal depth at an opening that lets through four times as much light. For example, a 2-inch lens at $f/3.5$ will have equal depth and four times the speed of a 3-inch lens at $f/5.6$, or twice the depth and eight times the speed of a 3½-inch lens at $f/8$.

This means that focusing adjustment is more essential for the "coat"-pocket camera than for the "vest"-pocket camera; and, when both have it, the larger camera needs more precise calculation in setting the focus accurately.

As to bulk, the difference is not great. But it may be just enough to mean that a vest-pocket camera would be kept constantly in your clothes, ready for business; while the coat-pocket camera would be the least bit burdensome or in the way, and consequently taken afield only with malice aforethought. That's the way it is with me, I know. For several years I have never started away from the house in the daytime without a vest-pocket camera on my person—and many are the unexpected pictures thereby secured. I would not do it with the coat-pocket size. [My favorite pocket camera is a very flat, roll-film camera, fitting the hip-pocket like a pack of cards, and giving a picture 2¼ x 2¼.—Editor.]

Size of image varies very little between the 3-inch and 3½-inch lenses—that is to say, it is practically as necessary to enlarge from 2¼ x 3¼ negatives as from the smaller ones. Cost of apparatus and materials differs very little between the two sizes.

Personally, I cast my vote for the vest-pocket camera with 3-inch lens, in preference to the coat-pocket camera with 3½-inch lens. Still, I wouldn't emphasize this

too strongly, for there is little to choose in the results obtained; and at the time this is written there is a much wider choice of cameras on the market in 2¼ x 3¼ size—the 3½-inch lens models.

Impossibly Small You know it is quite possible for a camera to be so small that it is difficult to handle. I have in mind a little jewel of a vest-pocket plate camera once in my possession, and the knobs and levers and what-nots connected with the shutter and other adjustments were so tiny that they were a little hard to get hold of—really not so convenient to work with as if they had been larger. This can easily be imagined to be the case in winter, when fingers are numb with the cold or hampered by heavy gloves. This is possibly one reason for the popularity of the Folmer & Schwing 2¼ x 3¼ Graflex, a wonderful camera, but not in the pocket class.

The Movable Front While considering apparatus, I want to urge as strongly as I can the desirability of every camera having a movable front, movable vertically, I mean, and often referred to as a "rising and falling front." This movement will be needed almost every time you photograph a building, to raise the lens so as to include the top of the building, and at the same time to exclude unnecessary and undesirable foreground. You may not need the rising front very often, but when you do have occasion to use it—like the life-preserver—you need it very urgently. I hope the camera-makers may come to see this as I do; evidently they do not, as yet, for some of the most efficient pocket cameras on the market, in every other respect, have not this adjustment.

Speed in the Lens As an aperture, *f*/4.5, makes a lens more than twice as fast as *f*/6.8, which is a powerful argument in favor of choosing the former lens. Again we may employ the life-preserver argument, and say that nine times out of ten *f*/6.8 or even *f*/8 will be fast enough, but that tenth time you may need the larger aperture and greater speed very, very badly. When used to embrace only a medium angle of view, as lenses are used in pocket-camera work, an *f*/4.5 lens will do everything that an

f/6.8 lens will do if used at the smaller opening. Just because a lens is capable of being opened up to *f*/4.5 is no reason why it should always be used at that opening. The little camera that is in my pocket now has an *f*/4.5 lens, but it is rarely that I use it wider open than *f*/8. When I want the extra speed, however, it is there.

Here is a phase of the lens question which I mention rather timidly, because I don't fully understand it. But it is a fact that *f*/8, for instance, in a 3-inch lens gives a stronger light action than *f*/8 in a 7-inch lens. The short-focus lens is faster at the same relative opening than a long-focus lens. My flashlight friend discovered this. He found that he got fuller exposure using a certain amount of flash powder with a miniature camera than with a larger camera—both lenses being used at the same relative opening. And I have confirmed his results. An attempt to explain this is made by saying that the small lens is faster because it has less thickness of glass, and so absorbs less light than the long-focus lens. I give this explanation for what it is worth.

Exposure Shutters

Shutters are more efficient in small sizes, too. It is easy to perceive that if shutter blades driven at as high a speed as is safe will open and close a lens aperture an inch in diameter in one-one-hundredth second, then a smaller shutter whose blades move as swiftly will open and close a half-inch aperture in one-two-hundredth second. And I fully believe that the indicated maximum speed in the smallest of such shutters as the Ilex or Compound marked "one-three-hundredth" is under-estimated, and that the actual working speed is faster than that. I say this after comparative tests of these little shutters against both a focal-plane shutter and a Multi-Speed shutter with various subjects.

Near Objects

The focusing adjustment should allow the subject to be as near as 3 to 4 feet from the camera. The first modern pocket camera I had, focused only to 9 feet—depending for closer work on supplementary lenses, commonly called "portrait attachments." That was a very poor arrangement, and hardly any improvement over fixed focus.

On a camera which is to be carried in the pocket, the lens should be covered when the camera is closed, to protect it from dust and damage. Otherwise, the camera must be inclosed in a separate case—a bother and source of delay in bringing the camera into action.

Films or Plates

Since most of the pocket cameras now available use roll film, little need be said as to the comparative merits of films and plates. Generally speaking, the respective advantages and disadvantages are the same in small as in larger sizes. Bulk and weight are objections to large plates that do not apply so forcibly in small sizes—a box of a dozen vest-pocket plates being scarcely any larger or heavier than a couple of six-exposure rolls of film for the same size camera. But the fragility of the small plate is a disadvantage. It may be said in favor of film that it is much more readily procurable in very small sizes than plates; so that if you run out of ammunition in Podunk Center, far away from the metropolis, the village druggist is much more likely to have film than plates. For rapid-fire work, a film camera can always be "fired" just that much quicker than a plate camera as the time taken to pull the slide out of the plate-holder. A loaded film camera contains within itself the "takings" for an afternoon's work; while, with a plate camera in pocket, there must also be loaded plate-holders in another pocket—two pockets full instead of one. Film-pack may be used with most plate cameras, though I cannot conscientiously recommend the pack; it has never given me as much satisfaction as either plates or roll film. In large sizes, film costs just about twice as much as plates, but in the smallest sizes there is not much difference in price.

2¼ x 3¼ Cameras

Of American roll-film pocket cameras in 2¼ x 3¼ size the two that come nearest to my ideal of what a modern miniature should be are the F. P. Kodak No. 1 Special and the Ansco V. P. Speedex. Both are obtainable with *f*/4.5 lenses, both have one-three-hundredths shutters, both have focusing adjustment. Unfortunately, neither has rising front; but perhaps the makers will remedy this in future models. The No. 0 Folding Ingento of

Burke & James is another good $2\frac{1}{4} \times 3\frac{1}{4}$ roll-film camera with rising front, which may be obtained with medium-speed anastigmat lenses as special equipment. There is no American-made camera that I know of, in the smaller size, for either plates or film, that has an *f*/4.5 lens or focusing adjustment. The European war has undoubtedly lessened the supply of the highly efficient miniature cameras made abroad; but a day's shopping in New York, or almost any large city, will still give the reader ample choice among the best varieties made here or abroad. The dealers' windows and the lists of dealers in second-hand instruments offer abundant proofs of this.

Exit the Large Hand Camera

As evidence of the growing popularity of very small cameras, it is interesting to glance over the catalogs of the past few years, and note how the manufacturers have found it expedient from year to year to discontinue the larger sizes of amateur cameras, and at the same time to supply high-class lens and shutter equipment in smaller sizes. One well-known maker dropped the $4\frac{1}{4} \times 6\frac{1}{2}$ size two or three years ago, and this was followed last year by the 4 x 5, leaving the 3-A or $3\frac{1}{4} \times 5\frac{1}{2}$ the largest amateur outfit. In the catalog of this particular maker, the only camera, large or small, offered with *f*/4.5 lens is in the $2\frac{1}{4} \times 3\frac{1}{4}$ size.

Enlarging

How does the operation of small cameras differ from methods followed with large apparatus? Principally in this—that enlargement is a necessary part of the process of making pictures with the pocket camera. We must always bear this in mind, and govern our actions accordingly.

Enlarging demands a certain type of negative—sharp, clean and clear, and not over-dense. Every blur and blemish in the negative will be greatly magnified in the enlargement, so that we must first guard against dust in the camera (and plate-holders, if it is a plate camera), then we must focus carefully, and hold the camera very steadily in making the exposure. And during all handling of the film or plates we must be on our guard against scratches.

In the case of a roll-film pocket camera, the back of the camera, inside, across which the film is wound, should be carefully polished with a clean lintless cloth every time the camera is unloaded. Some cameras close up so compactly that the folds of the bellows are pressed back in contact with the film. If this is the case, the film should be wound from one exposure to the next when the camera front is partly extended, otherwise the film may be scratched by the bellows.

The Hip-Pocket Despite the name "vest"-pocket, I have found my hip-pocket to be the most convenient place to carry a little camera. This is especially so in summer, when the vest is usually discarded, and sometimes the coat too. I am bound to say that film goes "bad" very quickly under such circumstances in hot weather—the heat and dampness in the atmosphere being aided and abetted in deteriorating the film by the warmth and moisture from the body. And if anything is in contact with the film, such as the folds of the bellows, in hot, damp weather, the result will be a mark on the negative. No such trouble is experienced in winter, when the air is cold and dry. But winter is the season of slippery sidewalks, when one is likely to sit down unexpectedly, suddenly and forcibly. When this is likely to happen, it may be questioned if the hip-pocket is a safe place for a camera in winter.

Avoiding Body Movement Hold the camera very steadily when making an exposure. This should be done with any camera, large or small; but the injunction has especial application to the operation of a little camera, because the results are to be enlarged. Much of the un-sharpness in hand-camera negatives, and therefore dissatisfaction in enlargements therefrom, is due to unsteadiness in holding the camera at the instant of exposure. I have operated the hand cameras of all sizes from the smallest pocket size up to and including 5 x 7, and I am of the opinion that a person having a fairly steady hand will experience less difficulty with a very small camera than with a larger one; but if the hand is naturally inclined to be a little shaky, such unsteadiness will communicate itself to a

very small camera, whereas the very weight of a larger camera might actually steady the hand.

The View Finder

Two forms of finders are in common use on pocket cameras—the reflecting or "brilliant" finder, and the direct vision. The latter type of finder seems to me more accurate if it is entirely without lenses or mirrors, consisting of a peep-hole at the back of the camera, and a wire frame attached to the front of the camera. Then, if the wire frame moves with the rising front, it renders the operation of this adjustment very certain and accurate; for the man behind the camera can tell by his finder just how much to raise the lens for the particular subject in hand. Some things can be done with the reflecting finder that are not possible with the kind just described. "Direct vision" means that your eye must be directed straight toward the object photographed. With a reflecting finder, however, the camera may be pointed at right angles to the way the operator is facing, and the subject still be watched in the finder. This is a very practical method of snap-shotting people unawares. Unless they take particular notice, they will think the camera man is shooting in the same direction that he is facing. With a reflecting finder, too, you can shoot over a crowd by holding the camera at arm's length above the head—the camera being upside-down so that you can look up into the finder.

Other Advantages

This seems an appropriate place to say that one of the chief advantages of the pocket camera is its inconspicuousness. People do not notice a little camera and stare at it, and dodge it, as they do in the case of a bulky "professional" looking outfit. And children do not at once spot your camera, rush to get in front of it, and make the time-honored appeal, "Take my picture, mister!" More than once, I have sauntered up to a man, taken out my vest-pocket camera and casually snapped the shutter almost under his nose, without his realizing that he was being photographed. The modern miniature is a real detective camera—a photographic dictograph! Imagine how much more effective it is for press photography than the bulky reflex apparatus hereto-

fore used for the purpose. With the modest, unobtrusive little pocket camera you can get the most intimate, personal and characteristic likenesses of people before people know it. The reporter off duty runs into a big story—and I mean by that some happening that has the makings of a newspaper feature—he doesn't have to telephone to the office to send up a camera man, because his own capable miniature is in his pocket. I am not a press-photographer, but I am a newspaper man and a photographer, and I know enough about the requirements of newspaper photography to realize that the well-equipped miniature camera is *the* outfit for such work.

Because it can be carried in the pocket, ready for action at all times, without being a burden, the miniature camera catches many views that otherwise would be lost. The other day a building near our office caught fire. It was a spectacular blaze and threatened the whole neighborhood before firemen finally got it under control. I snapped several excellent pictures with my pocket camera while the fire was in progress. The point is here—I shouldn't have gotten those pictures if it were not for that camera always in my hip pocket. There was time enough to go home and get a camera, it is true, but I shouldn't have ventured to do that, because the blaze was so uncomfortably near our own quarters that we momentarily expected to have to quit and run with what could be carried. Then there is that sunrise or sunset effect—some peculiar unexpected lighting that you never encountered with the faithful old 5 x 7—out comes the pocket camera, and it is yours. Nothing can get away from you.

Focusing

Focusing on the ground glass is one of the delights, and necessities, of working with a large camera. Not so with a pocket instrument. It is true that the little plate cameras have a ground glass; but practically it is not of much use, because with a 3- or 3½-inch lens the image is so small and the details so microscopic that one can do better by trusting to the finder and focusing-scale. The natural and correct inference is that the finder and scale need to be very accurate—the finder

must show just that part of the view which the lens will include on the film or plate, no more and no less; and when the indicator points to 10 feet on the focusing-scale, the lens must be as sharply focused for that distance as if a ground glass had been employed and the image scrutinized with a magnifier.

Estimating Distances

It has been said "hereinabove," as the lawyers put it, that focusing must be carefully done with a pocket camera, because the pocket-camera negatives will probably be enlarged. This is true. But the distance from the camera to that object in the view which is to be in sharpest focus does not need to be estimated so accurately with a small camera as with a large one, because the short-focus lens has such great depth. This must necessarily be so, or it would be entirely impractical to have a pocket camera of fixed focus. As a matter of fact, though your pocket camera has focusing adjustment, it may be used as a fixed-focus instrument for all subjects at a greater distance than about 15 feet—drawing out the lens for each exposure to the hyperfocal point on the scale. Like the rising front and the $f/4.5$ lens opening, however, the focusing adjustment is a reserve to fall back upon in case of need. The closer the subject is to the camera, the greater need for careful focusing. Here is where practice brings skill in greater or less degree. Each worker must determine for himself, by experience, how far (or how near) he can trust his judgment in estimating distances. There will be a point nearer than which he will find it prudent to check his judgment with a foot-rule—which point will be nearer with a small camera than with a large one. I can usually hit the focus near enough by guess as close as 3 feet, with a 3-inch lens at $f/4.5$. With a 7-inch lens at $f/6.8$ I hardly dare to risk my judgment as close as 6 feet. If you err at all, err on the near side—that is, have the focus nearer than the object, in preference to farther away. If your subject is a group, it is best to have the nearest figures in sharpest focus; and, in taking a portrait, there should be no part of the head more clearly defined than the nose and eyes, the definition of the eyes being especially important.

A Fine Point There is a point to be thought of here in comparing plates with roll-film and film-pack. Plates may always be depended upon to present a smooth, flat surface at precisely a given distance from the lens. Therefore with plates the focus may be determined most accurately. Roll-film does not lie quite so flat—there is sometimes enough inequality of the surface to affect the sharpness of focus. Whatever curl there is to roll-film, however, is always away from the lens, which makes the focus err "on the near side." But film-pack is as likely to curl or bulge one way as the other—depending somewhat on the state of the atmosphere—so that you can never be quite sure with film-pack whether your focusing-scale is telling you the truth or not. The "depth" of the short-focus lens, however, will somewhat compensate for this.

When Using a Ray Filter A ray-filter slipped on over the lens alters the focus slightly. With the filter in position, the lens should be just a wee bit nearer the plate or film than it would be without the filter. This does not matter much except with large lens-opening and distant subject, and whatever error in focus is introduced by the filter is "on the near side." This emphasizes the advice already given to favor the near side when focusing.

Development The development of pocket-camera negatives differs from the development of large negatives only in this respect—that we must be careful to adopt that method of procedure which shall insure a clean, clear negative, not over-dense; because that is the sort of negative which gives the best enlargements. Scratches, dust-marks, finger-marks, must all be carefully guarded against. Tank development eliminates most of the handling of the sensitive material. It also precludes the danger of fogging by the darkroom light. The tank is for these reasons recommended in the development of pocket-camera exposures, because it gives clean, clear negatives; and, with development by time and temperature, the density of negatives may be pre-determined with considerable certainty.

A Remarkable Confession

No, I don't use a tank myself. I have used them—pretty nearly all sorts—for plates, roll-film and film-pack. But I am old-fashioned enough (perversely conservative enough you may say) to prefer to run my exposures through a tray, by hand; and what developing-tanks I still possess I use for washing-boxes. It is no hardship to develop a half-dozen small plates at once in a large tray, and I always considered it easier to develop a short-length strip of film by see-sawing it through a tray of developer than to use a tank. If you develop film in the tray, have the face side up, so it will not scratch against the bottom of the tray. Film-packs, I do believe, are more conveniently handled and more evenly developed if done in a tank. The reason I do not develop in the tank is because, in my opinion, the gradation is apt to be not so good in tank-developed negatives. They are also likely to exhibit a peculiar "edging" where high lights and deep shadows meet, which is sometimes very noticeable in an enlargement. Many workers, however, use the tank with complete satisfaction; and I recommend it, if I may do so consistently without practicing what I preach.

The Perfect Negative

Very dense black negatives do not make good enlargements. Neither exposure nor development, therefore, should be too long. The ideal negative for enlarging is secured by an exposure that is only just sufficient to register the required shadow details, followed by development in a clear-working developer only to that stage when the darkest parts of the film are moderately dense. I have here, as I write, such a negative—an outdoor view. As I hold this negative up to the window, I can see through the densest parts of it. This negative makes a bright, crisp print on Normal Cyko, or on Soft Cyko it gives a softer, more harmonious result. It enlarges to perfection on Enlarging Cyko. How can you always be sure of securing negatives of ideal contrast and density? You can't. However, you can aim for the happy medium, and be likely to hit somewhere between the extremes; so that amongst the grades of hard, normal and soft gaslight papers, one

or the other of them will suit all your negatives. Under-development is better than over-development. It is a shadowy ghost of an image, indeed, that will not give enough contrast on the hard grades of gaslight paper; and it is a simple and easy thing to intensify a negative that is too thin. On the other hand, development does not have to be greatly prolonged to give a negative so dense and contrasty that no printing paper will yield a harmonious result from it.

After Methods

When your negatives are developed, fixed, and thoroughly washed, and still wet from the last wash-water, go over them carefully back and front with a tuft of cotton, to remove the superfluous moisture and any little specks of dirt that may have lodged on the surface of the film.

Retouching is not recommended for negatives that are to be used for enlarging. Pinholes may be touched out with a fine-pointed brush charged with opaque. This will result in a white spot on the print, which will, in turn, have to be spotted out. Cleanliness and care, the need for which I have taken pains to emphasize, in the production of negatives, will largely prevent pinholes, dust-marks and other blemishes. Having used all possible care, however, you will still be able to improve the appearance of enlargements by the judicious use of spotting colors.

A Plea for the Enlarger

You will have to enlarge, no matter what sort of little camera you use. I say *you* will have to enlarge. This presupposes that you will do your own developing and printing, and not leave it to someone else. I hope that this may be the case, and I use the first and second persons in making this appeal, so that it may be more direct. The results of amateur photography lose much in individuality because of the necessarily machine-like methods of the commercial finisher—when the printing is by contact. It is even more necessary to exercise powers of discreet selection in enlarging.

What Enlarging Means

"Enlarging" does not necessarily mean the production of 8 x 10 or 11 x 14 prints. An enlargement of two diameters will bring the vest-pocket picture up to very near post-

card size, or the $2\frac{1}{4} \times 3\frac{1}{4}$ to almost 5×7; which will probably be large enough for the album or for separate mounting. Larger prints may be made, if desired, of course, for hanging on the wall; and a needle-sharp negative will stand bringing up to ten or twelve diameters, as far as satisfactory detail is concerned, although the grain of the film will begin to show disagreeably beyond about six diameters. It is not compulsory to enlarge from the entire negative. The whole picture may be contained in a little section of the negative an inch square, which may be enlarged to $3\frac{1}{4} \times 4\frac{1}{4}$ or 4×5. Only be sure in making the exposure that you have included enough. Then exercise judgment and selection, and bring to bear what knowledge you have of composition and balance in making the final enlargement.

Enlarging from a part of the negative to a print the size of the whole is equivalent to a direct print from a negative exposed with a longer-focus lens, with the advantage of greater depth and speed possessed by the short-focus lens. The "take it small, then enlarge," method thus discounts the advantages claimed for a type of lens which may be divided into components of different foci.

Apparatus

Artificial-light enlarging apparatus is available in very great variety. Electricity is required for use in most of these, although some enlargers may be operated with incandescent gas lamps. The Cooper-Hewitt M-shaped tube is probably the most efficient form of illuminant for enlarging, and will, without doubt, supersede the arc light for all photographic work such as enlarging, copying, and home portraiture. The gas-filled tungsten or nitrogen Mazda is bright enough for all practical purposes, and is now available with most of the enlargers in the market. There is advantage in being able to use the same apparatus for both enlarging and for the projection of lantern-slides. Several types of enlargers are adapted to use for projecting, and several models of stereopticon projectors may, with a proper lens and suitable adapters, be employed for enlarging. The reader will do well to make sure that his apparatus is capable of such interchangeable use.

This seems an appropriate place to say that the usual projection lens of a stereopticon lantern is not suitable to use for enlarging. The reason is that the lens is not properly corrected for such use, and will give a sharply defined enlargement only by employing a very small aperture, which cuts down the light and necessitates a fatally long exposure.

Home-Made Enlargers

These are quite as effective as those of the ready-made variety, if properly constructed—which condition depends somewhat on the mechanical skill of the worker. Almost every issue of the current photographic magazines contains an article describing some form of home-made enlarging apparatus, with diagrams giving details of construction; and, of course, there are many instructive little booklets on the subject of enlarging, among which may be mentioned THE PHOTO-MINIATURE No. 123 (now out of print, but available in many public libraries), in which are found very explicit directions for making enlargers for either artificial light or daylight. The majority of my readers, however, will prefer to give their time and skill to the actual enlarging rather than to the making of apparatus. For these THE PHOTO-MINIATURE No. 144: *Enlarging on Development and Bromide Papers*, will be a helpful guide. Where an artificial illuminant is employed, I believe there is real advantage in a vertical form—that is, where the light source is elevated and the rays shine down vertically through the negative and lens, and so on to the sensitized paper. Such an arrangement certainly takes less floor-space than the horizontal form, and the heat from the lamp is less likely to have a harmful effect on the negative. The paper is also more easily secured on a horizontal surface.

Daylight Enlarging

Daylight is the cheapest and coolest illuminant for enlarging. Both qualities are worth considering. No condensers are used, and the other apparatus required is of the simplest. The photographer who depends upon daylight for enlarging, however, must have a room that can be entirely given over to his operations, at least temporarily. Provision must be made for closing out all the

light except from one window, and all the light from that window except through a single opening a little larger than the negatives which are to be used. If these conditions can be fulfilled, and if the photographer can spare time for the work during hours of daylight, this is a very satisfactory method of procedure. Objection is made to daylight for enlarging purposes on the ground that it is variable—a passing cloud may upset all calculations as to length of exposure. This is quite true. But experience will enable the operator to judge the light with a fair degree of accuracy, even if there are some clouds; and then, of course, the amateur can usually wait for a clear day when the light is constant and steady. For occasional enlarging, daylight is very satisfactory and has much to recommend it. Most of my own enlargements have been made by daylight with a very simple arrangement, consisting principally of two cameras on a long board which is tilted up at a window; and no one could ask for a more efficient outfit. But one who enlarges much and often, or who cannot spare much time except at night, must not depend on daylight.

Simplest of all enlarging apparatus is the fixed-focus-box affair, of which the Brownie enlarging camera is typical, designed primarily for daylight but adaptable also to artificial light by means of a special illuminator. Here the process of photographic enlargement is reduced to its lowest terms. The negative is placed in one end of the box, the sensitized paper in the other. Then the whole thing is turned up to the light. That's all. Within its limitations, the fixed-focus enlarger is quite efficient. The limitations are that it gives but one degree of enlargement—two diameters, usually; and the lens, owing to its meager correction, has to have a very small stop; therefore a long exposure is required. It is quite possible, however, to substitute a better and faster lens.

The Enlarging Lens

Anastigmat lenses excel other types because they will give a sharply defined image over a wider area with a large aperture. It should not need any extended argument or explanation to show that, because of these very

qualities, the anastigmat is the lens par excellence for enlarging. The gain is in speed. For instance, while a single lens, such as is provided in the fixed-focus enlarger, might require a stop of the value *f*/32, and a rectilinear at least *f*/16, the anastigmat would give as good and perhaps better definition at its largest opening, which, we will say for illustration, is *f*/5.6—eight times as fast as *f*/16 of the rectilinear, and thirty-two times as fast as *f*/32 of the single lens. Anastigmat lenses of the highest type are furnished as part of the regular equipment on the best little cameras of today—exactly the sort of lens that we have said is best for enlarging,—and it is quite practical to use the pocket camera itself, with its excellent lens, as the main part of the enlarging apparatus. Just such provision in the form of enlargers has been made by several makers of small cameras—notably those of Goerz, Gennert, and Folmer & Schwing.

Gaslight Enlarging Papers

Better enlargements can be made on gaslight paper than on bromide paper, from the general run of negatives, principally because gaslight papers come in various grades yielding different degrees of contrast—and therefore suiting negatives of varying contrast, the same as in contact printing,—whereas bromide paper, though provided in different grades, is all rather soft-working, and not capable of producing a bright print from a flat negative. Gaslight paper, as the reader probably knows, comes in three grades—hard paper for soft negatives, medium or normal paper for negatives of that class, and soft paper for hard negatives. Now the negative that requires hard or contrast paper for contact printing also requires that grade of paper for an enlargement; and so other negatives whose contrasts may be best suited by normal or soft paper for contact prints also demand those papers for enlargements. Selection of paper to suit the negative is afforded in gaslight emulsions—not in bromide emulsions. And especially for amateur use is gaslight paper a better enlarging medium than bromide, because it is simpler and easier to handle, and, being less sensitive to light, does not require a darkroom. The advantages of gas-

light paper for enlarging are very fully set forth in THE PHOTO-MINIATURE No. 144, entitled *Enlarging with Development and Bromide Papers.*

Diffused-Focus Enlargements Up to this point, we have seemed to consider extremely fine detail as much to be desired in our prints, and that is probably what most photographers strive for. Certain advanced workers, and others who like to think themselves "advanced," favor diffused focus for some subjects. This diffusion is easily secured in the process of enlargement, no matter how sharp the original negative may be. Indeed, I believe the most satisfactory way of producing soft-focus prints is to make the negative as sharp as possible with a fully corrected lens, and then make the print—large or small—by projection with a semi-achromatic lens. Working in this way, the diffusion may be varied at will—from absolute sharpness to chaos and oblivion. If the negative is made with a soft-focus lens and the prints by contact, the degree of diffusion is fixed once and for all, be it too much or too little or happily just right.

Lantern Slides Only one person at a time may comfortably view a collection of prints contained in an album, but a whole roomful of people can be entertained with a stereopticon and a collection of lantern-slides. Owners of pocket cameras will find that their negatives are just the right size to make satisfactory slides by contact—the field projected by the average stereopticon being about 2¾ inches square. The making of lantern-slides is very interesting, and not more difficult than printing on gaslight paper. Indeed, the procedure in making a slide by contact is almost exactly the same as in printing on paper, the lantern-slide plate being substituted for the sheet of sensitive paper. The only difference is that the plate is much more sensitive to light than gaslight paper, so it has to be loaded into the printing-frame and developed in a room illuminated only by red light. Being so much more sensitive to light than gaslight paper, the exposure of the lantern plate under the negative is correspondingly less—a suggested trial exposure being five to ten seconds at 10 feet distance

from an open gas-burner. Hydroquinone is recommended as a developer in preference to the usual M. Q. After the slide is dry, it has to be bound up with a clear glass of the same size with a black paper mat between, the mat being cut out in the center to fit the picture. The cost of all materials for the making of a complete lantern-slide will be about ten cents. The same quality of negative prescribed for enlarging—clean, clear and not over-dense—will be found right also for making lantern-slides. Beware of dust at all stages of the process of slide-making.

Enlarged Negatives It may be desired to make enlarged negatives for certain printing-papers. Such negatives are not hard to make. The process of making demands an intermediate positive between the original negative and the final enlarged negative. This positive may be made by contact, the same as a lantern-slide described in the preceding paragraph. A lantern-slide plate is suitable to use for this purpose, but the exposure may well be a little more generous and the development a little less than in the making of a slide; so that the result will be less transparent in the high lights and more so in the shadows. This is to preserve intact the complete scale of gradation that exists in the original negative. The next step is to proceed exactly as if a paper enlargement were being made from a negative—substituting the positive for the negative, and substituting a sensitized plate for the usual gaslight or bromide paper. The result is an enlarged negative. Another way of doing it is to make the positive enlarged, by projection, the same as in making a paper enlargement, and then produce the final negative by contact. I have worked both methods, and while there is practically no difference in the results, I prefer the second plan because then there is opportunity to do retouching and to make alterations on both positive and negative. Working in this way, it is possible to do much toward remedying defects that may mar the original small negative; such as modifying an objectionably obtrusive background, remodeling it, or eliminating it altogether. There is another advantage which accrues from the production

of a second negative, in the power to alter the general contrasts. With hard-working developer and slow contrast-giving plates, the second negative may be made much stronger and snappier than the original; or with a normal developer and fast plates, the reproduced negative may be made much thinner and softer than the original. It is easier to reduce contrasts than to increase them. This is the safest way to reduce a negative—to reproduce it. Gaslight papers may be used for contact printing from enlarged negatives, of course; but the particular object in view is usually the use of printing-out papers or platinum, which it is not practical to print by projection because of their comparative slowness. Guard against dust carefully. Such precaution will save much retouching.

Contact prints from miniature negatives have a charm all their own, though they are so small that an album full of them reminds one of a collection of postage stamps. I have it in mind to fill an album with miniature prints, one of these days. When I do that I shall provide with the album a large reading glass for the greater enjoyment of the pictures.

War and the Pocket Camera Reference was made before to the fact that the European war has interfered with the importation of miniature cameras into this country from abroad. But what effect the war has had on the further development of European miniature cameras we can only conjecture at this writing. We realize, intuitively, that such cameras must have proved their efficiency on the battlefield. In England, vest-pocket cameras, chiefly the Vest-Pocket Kodak and the "Ensignette," were sold in large quantities both to privates and officers in the early stages of the war. In fact, it kept the apparatus trade from a slump, as did also the developing and printing of films which came back from France and Flanders in large numbers during the war period of 1914 and the early part of 1915. Then there was a War Office prohibition of cameras among men on service, although no doubt there is still a good deal of photography done clandestinely with such cameras as the vest-pocket. I see in an Australian photographic magazine the story of a

camera worker who is with the British army. He says that photography is being much used in military operations, and tells of being detailed to secure photographs of the enemy's position from an aëroplane. He says he was surprised not to be furnished with a reflecting camera, but the censor will only let pass a meager hint of the "astounding, ingenious" type of camera that was taken up into the clouds—a miniature without a doubt. One very interesting story is to the effect that there was such a demand for shrapnel-proof cameras that manufacturers furnished miniature cameras constructed of steel, and that in more than one instance these armored cameras, being shrapnel-proof, saved their owners' lives.

Pocket Cameras for Serious Work

"A small camera does not necessarily displace the larger one;" but it is quite capable of doing so. The words in quotation marks I saw recently in the advertisement of a pocket camera. The rest of the sentence I supplied myself. Provided that the lens and shutter of the pocket camera are equal in quality and range to those of the larger camera, and that both instruments have similar adjustments, and provided further that equal care and skill are employed in using them, the little camera will produce better results. Amateur photographers have discovered this fact; professionals are on the eve of discovery.

I have had some correspondence on this subject with various camera manufacturers. No confidence will be violated, no names being mentioned, if I quote herewith from a letter from a well-known manufacturer—one who caters especially to professionals:

"The question of using a small efficient camera and enlarging, as stated by you, is one that we have agitated for years, but with only a small degree of success. [Possibly because the agitation was not put into the firm's advertisements, where alone it could produce results.—Editor.] The professional photographer who desires to do home portraiture, it seems, cannot be induced to use smaller than 8 x 10 size of camera, which, as they put it, gives the 'correct appearance or tone of professionalism' that a small camera would not give. And it is a difficult matter to disabuse their

minds of the idea that a small camera looks too amateurish, when it is as a matter of fact fully as efficient, if not more so, than the large, more unwieldy camera."

There is something in that. It shows that the professional must not only himself learn of the advantages of small cameras and short-focus lenses, but he must also teach his customers that the insignificant-looking little apparatus is quite able to "deliver the goods." [There need be no difficulty in such teaching. The customer is really interested in the results and, if the professional can "deliver the goods," the size of his apparatus will not interfere with his success.—EDITOR.]

We cannot altogether blame the professional photographer for not taking very kindly to the modern pocket camera, for the types of these cameras thus far produced have not been designed with particular regard to the requirements of the professional. Compactness is a virtue in the construction of a camera that is intended to be slipped into a vest-pocket. But, as we said before, it is quite possible for a camera to be so small as to be difficult to use—hard to "get hold of" in manipulating the various adjustments; or so exceedingly folded in upon itself, when closed, that creases in the bellows press back and make marks on the film. Then again, what pocket camera is there on the market that provides for wide-angle work, such as the professional is so often called upon to do? Not one! A 3-inch *f*/6.8 anastigmat of the best type will cover a 3¼ x 4¼ plate well at *f*/11, thus embracing a very wide angle. It has no chance to do so, however, when fitted to a 1¾ x 2½ camera. The modern miniature camera is so compact that it is restricted in the freedom and scope of its capabilities. [Query: Whether this fault be not a virtue. Wide-angle portraiture is notoriously untruthful, rarely pleasing, and always an abomination.—EDITOR.]

The Ideal Suggested What the professional needs to secure the advantages of the short-focus lens is not exactly a vest-pocket camera, but something about 3¼ x 4¼, built on the lines of a view camera, with swings and ample movement of the front, an *f*/4.5 lens for portraiture and other work where speed is essential, and an *f*/6.8 lens of 3 inches focus for

wide-angle work, interiors, etc.,—these two lenses being quickly interchangeable, and the camera being provided not only with finders but also with ground glass, and with accurate focusing-scales for both lenses. Such an outfit would put in the shade any 8 x 10 equipment that I ever saw or that I could imagine. I know something of what the capability would be, because I have a 3¼ x 4¼ camera fitted with such lenses. My cameras are numerous and varied, and in size range from the smallest miniature up to 8 x 10. When I am called upon, as I am sometimes, for a day's photographing which is likely to include anything and everything, the 3¼ x 4¼ with its short-focus lenses is the one I take—because I know that is the most capable camera I have. On these trips, I don't forget to take the little miniature in my hip-pocket—its roll of film is often called upon after the 3¼ x 4¼ plates are exhausted.

Consider the difference in bulk and weight between an 8 x 10 camera, twenty-four plates in holders, and a sufficiently staunch tripod—one man would be hardly able to lug it about—and a corresponding equipment in 3¼ x 4¼ size, which could be carried in one hand without fatigue, camera, case and loaded holders, tripod and all! And, when it is demonstrated that the smaller camera will produce better results in prints of the same size, do you wonder I call it *perverse* conservatism that leads the professional to stick to his 8 x 10? There may be something in the "correct tone of professionalism" mentioned by my correspondent, but I believe comfort and convenience in operation and quality of results are much more worthy of consideration.

Interior Photography

Wide-angle work, such as is encountered in photographing interiors, is especially well accomplished with the short-focus anastigmat in the modern way—"take it small, then enlarge." Discerning photographers will, I am sure, recognize an 8 x 10 camera with 7-inch Goerz Dagor lens as a most efficient outfit for wide-angle interior photography. I have that equipment and can testify to its efficiency. Comparative tests convince me, however, that I can get even better results by using a 3-inch Dagor on a 3¼ x 4¼ plate, and mak-

ing 8 x 10 enlargements. I have in mind one particular occasion when the smaller outfit demonstrated its superiority. There were four exposures to be made in the library of a city residence. This room had windows on one side only. They opened on a court and gave only very scant illumination. The woodwork was very dark in tone, and on the floor were rugs of a deep red—altogether a pretty tough proposition from a photographic standpoint. It was desired that the photographs should show a certain lighting effect caused by the sunlight streaming in at the windows, which effect, of course, could not be obtained by a flash or other artificial light. At that particular season of the year the sun shone into the library for only a little over an hour in the middle of the day. With the 3-inch lens and 3¼ x 4¼ plates the four views were made within the hour, by giving each an exposure of ten minutes with the lens wide open—*f*/6.8.

We have explored some of the advantages and possibilities of the modern pocket camera, which are due to the high efficiency of the short-focus anastigmat lens; and we have digressed somewhat to show how that same efficiency may be employed effectively in serious "professional" photography with smaller apparatus than is now generally used; though not necessarily with so small a camera as the vest-pocket model. I hope I have not over-emphasized the necessity of exercising care and skill in the operation of small cameras. The best results are obtained with any tools only by careful use. We have by no means exhausted a subject which is not only highly interesting in itself, but which also holds great possibilities for the future of photography. American camera-makers have here and now an opportunity, which they should not neglect, to take a worthy part in developing this phase of photography. This is the day of the little camera!

Charles F. Rice.

Color Portrait from Life

Reproduced from an Autochrome by John W. Allison, with Panchroma Flash Powder

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Practical Instructions in Color-Photography

Not so very long ago, I prepared for THE PHOTO-MINIATURE (No. 128) an explanation of the modern methods of making photographs in color. The monograph was not a manual of practical instruction. It made no pretension to be one, for the systems and principles upon which color photography depends provide quite enough material for a whole number of this magazine, and indeed would not be exhausted in several issues, were I tempted to explore the by-paths of adventure which inventors have explored in the search for the ideal in color photography,—that is to say, a process as rapid, easy, complete, and inexpensive as the methods for making ordinary prints or enlargements. However, the earlier monograph did provide a comprehensive survey of its subject, and, though its scope is the theory or principles of color photography, it is a plain story, such as the most non-scientific of us can grasp without difficulty. It is, in fact, an absorbing narrative told without long words, as I realized again by a recent re-reading of it.

But more requires to be done. However interesting it may be to read or study the ways and means of color photography, we are not likely to be contented except by adding the practice of it to our experiences in picture-making. The rendering of the colors of

nature has been the dream of photographic experimenters almost from the moment when Daguerre announced his discovery to an astonished world. The dream has been prodigiously slow in coming true; but it has at length been realized in fact, and has been accomplished in several quite different ways, two of which have come to completion within the past two years by the researches of American workers.

And so, in the present monograph, we shall turn from theory to practice, and shall set before the reader just that practical instruction necessary for success in the making of "color photographs," using that term to denote transparencies on glass as well as prints on paper. The processes we shall consider are four in number: viz., the Autochrome and Paget methods of making color-transparencies, now firmly established in this country and among European workers; the Hicro process of Mr. F. E. Ives, for the production of both transparencies and prints; and, last, the Kodachrome two-color process of the Eastman Co., devised specially for the making of portrait transparencies in natural colors, and of more particular application in professional photography. Even with this limitation of our text, and passing over processes which cannot yet be called fully practical, it will be necessary to refer the reader to THE PHOTO-MINIATURE (No. 128) for the "why" of the present methods. Here our concern is strictly with the "how."

Color Screen-Plates

The Autochrome plate, issued by MM. Lumière, of Lyons, France, in 1907, is the first commercial form of the color "screen-plate;" that is to say, a plate which bears a coating of minute intermingled transparent patches, red, green, and blue-violet in color, which record upon a sensitive emulsion, in contact with it, the redness, greenness and blueness of the subject before the camera. The Autochrome plate has the sensitive emulsion coated on the film of color patches; in the Paget process a separate plate is pressed against it. The first result of exposure in each case is, of course, a negative, which, in the Autochrome process, yields a picture in complementary colors, that is, yellow

instead of blue, pink instead of green, and so on, due to the negative image leaving uncovered exactly those elements in the color-film which did *not* transmit the colored rays from the subject. But this negative image, as we shall see, is readily converted into a positive one, and then it is the elements corresponding with the original colors which remain uncovered and merge into one another, to reconstitute upon a reduced scale the color scheme of the original scene.

In the Paget process, the same final result is obtained by printing a positive transparency by contact from the separate negative, and building it up in register with a color screen identical in pattern with that through which the negative was taken. This latter plan reduces cost, as one taking-screen serves again and again, and it also allows of any number of color transparencies being made from one single exposure. So much for the bare outlines of these two screen-plate methods. Now let us come to the practical details of the older and more widely used process, the Autochrome.

What Size Autochrome? The first thing to decide is what size of picture we shall choose. The Autochrome plates are made in sizes from 1¾ x 2⅝ to 8 x 10 in. Here their cost is roughly four times (in Britain, 8 times) that of ordinary plates, so that expense will be a prime factor in selecting a size. If the results are for lantern projection, then obviously choice will be made of the 3¼ x 4¼ or the 3¼ x 3¼, the latter the standard British lantern size. But, if one's aim is to make larger transparencies, the alternatives are the 4 x 5 and 4¾ x 6½ in. (or 5 x 7 in.) sizes, either of which affords a picture of ample size. The largest size of all (8 x 10 in.) is one which few amateurs will wish to adopt, when it is considered that each plate costs considerably more than $1; although it should be said that the bulk of the expense of the process is in the plates. Chemicals, etc., cost no more than for ordinary photography.

The Camera In Autochrome work, the camera must be used on a stand. The plates are not rapid enough for shutter exposures. Apart from the means for holding the plates,

to which I will come in a moment, the particular model of camera is not a matter of importance; but there is some advantage in having one a size larger than the plates. The reason for this is that, by holding each plate in a kit (carrier), it is possible to hinge the black card (which has to be placed behind each) to the kit with a strip of gummed paper, and so to prevent its damaging the film by rubbing against it. This applies to plate-holders of both the American and English (book-form) patterns.

If the view is focused on the ground-glass of the camera by eye in the usual way, it may be necessary to turn the focusing screen the other way about, i. e., with the ground side to the rear. But this is necessary only when the special light-filter or ray screen is fixed on the front of the lens, for the reason which we shall see directly. The best position for the filter is behind the lens, and, if it is placed here, focusing may be done by the scale fixed to the camera. However, considering the cost of each exposure, it is much better to focus and arrange the subject by eye than to trust to any focusing scale.

Plate-Holders

But the most important feature in the outfit is the type of plate-holder. Undoubtedly the English book-form model (*Anglice*, dark-slide) is the most convenient, for the reason, just stated, that the plate can be laid in (glass side to the front), and the backing card brought against the delicate film surface without rubbing it. With the solid pattern of plate-holder, it is not so easy to adjust matters satisfactorily in this respect, if the camera is the bare size of the plate. But by using a kit the plate can be laid in, the hinged black card placed over it, and the whole then inserted in position in the holder, with the film side of the plate securely protected. With holders of the pattern in which two plates are slid in from one end, I advise their being carefully bound up with the black card (or two cards) between them before insertion in the holder, otherwise the film is almost certain to become rubbed in the process.

The Lens There is nothing special about the lens for color processes, except that it should be one of high-grade, fairly large aperture, and free from color. The aperture should not be less than $f/8$, is better if $f/6$, whilst a speed of $f/4.5$ is very often of real advantage. Apart from the shortening of exposure, and therefore lessened risk of movement in the subject, a large aperture, such as one or other of those just mentioned, yields a better result than that obtained with a lens at $f/16$ or smaller. The Autochrome differs from ordinary plates in this respect to a marked degree, so one of the first rules I would impress is to use the full aperture of the lens whenever that is possible. $f/6$ is about the most useful for all-round work. As regards focal length, you will not go far wrong in using a lens of focus a little longer than the long side of the plate. It cannot well be much shorter than this, for then it will be found not to cover the plate, and it is necessary to avoid extra length of focus (desirable as that may be pictorially), for then it is impossible to combine good depth of focus with the use of the full aperture. Generally speaking, an anastigmat type of lens is the best; although some workers have made good use of a soft-focus objective, on account of its pleasing massing of tones. But such a lens requires to be one in which the diffusion is obtained by spherical aberration, not, as with some, in part by chromatic aberration.

The Filter This is a most important part of the outfit. It is used in order to compensate for the extra sensitiveness of the plate to blue rays, and therefore only the special filter made by MM. Lumière may be used. The filter may be placed either in front of or behind the lens. If on the hood, care must be taken to attach it so that not an atom of white light can get between it and the lens. Any slight leakage, which would be of no moment in orthochromatic photography, will cause a bluish tint in the Autochrome. If by accident the filter is not used in making an exposure, the result is a transparency, with scarcely any color but blue in it. The Autochrome light-filters are supplied both square and

circular, and either shape may be fixed to the lens by means of a ray-filter holder, of which several patterns are made by the Eastman Company for their Wratten filters, either to fit the lens-hood or to be fixed behind the objective. A very effective holder for a square filter on the hood can be easily made as follows: Cut two pieces of three-eighths-inch whitewood, each one-half inch larger each way than the filter, making a central aperture in each a shade larger than the lens-hood. Then cut three strips of wood the same thickness as the filter, one-fourth inch wide, and also half an inch longer than the filter. Glue these flat around three sides of one of the square pieces, and then glue down the second piece on to them, finally cutting off two short lengths which project. All the pieces should be dead-blacked on both sides before putting together. Completed, they form a kind of open narrow box, or cell, into which the filter is lowered. One central hole pushes on to the lens, or a deeper brass rim may be screwed to the holder and lined inside with black velvet for greater security. The filter, which should be about half an inch larger than the diameter of the lens-hood, is thus secured on all sides from passage of white light. A similar device can be used for fitting the filter behind the lens, if the tube projects far enough, or the screen can often be more simply attached to the rear side of the lens panel by glueing a narrow shelf for it to rest on and fixing a couple of turn-buttons to keep it in place. So long as the filter fully covers the lens, there is no need to worry about a light-tight joint, since its position inside the camera excludes the possibility of stray white light.

Placing the Filter

It is most important to keep the filter protected from light when not in use, for, with much exposure to light, the filter darkens somewhat, and then upsets the proper color-rendering and also prolongs the exposure. With ordinary care, a filter may be kept in use for years without undergoing any change, but it must not be regularly carried on the lens, exposed to the bright light which would fall on it in the course of a day's work out-of-doors. For this reason, it is better to

fix it in the camera, and so to save the trouble of taking it in and out of a case, or forgetting to use it. There is another reason for preferring the behind-lens position, namely, that then we can avoid reversing the focusing screen in its frame in order to compensate for the plate being placed glass side to the lens. This may appear mysterious until I explain that the result of interposing a flat glass filter in the path of the rays from the lens is to throw back the focus by a distance equal to one-third the thickness of the filter. Now, in exposing an Autochrome, there are in reality two filters—the yellow ray-screen and the glass of the autochrome plate itself. The thickness of the yellow filter is 3 millimetres; that of the plate averages 1.5 millimetres. Hence the setback of focus is 1.5 millimetres, which is exactly the average thickness of the plate. Thus we can work on one or the other of two plans, whichever is judged more convenient: (1) Use a camera with the focusing screen in its ordinary position, focus *without filter*, and bring the filter into position *behind the lens* for exposure; or (2) use the ground-glass in reversed position, focusing *with the filter in place behind the lens*. If the filter is used on the front of the lens, the ground-glass must be reversed, and focusing may be done either with or without the filter, as the latter is then without effect on the focus.*

Whichever plan be used, it is worth while to compare the thickness of the focusing screen with that of the Autochrome plates; and, if there is any appreciable difference, to get a fresh piece of fine ground-glass.

The Autochrome Plate

So much for our equipment. Before we go on to make our first essay in Autochrome work, we may dwell, for a moment, on the special properties of the Autochrome plate, since these plates must be handled with much more than the usual care in several respects. First, the Autochrome is highly color-sensitive. It is fogged by deep red light, much as an ordinary plate is fogged

*This is so only when the subject is a considerable distance away, e. g., a general view. It does not hold good when copying very near objects, i. e., when the lens requires to be racked-out much beyond its normal extension. In such conditions, it is best to use the filter behind the lens.

by white light. The only safe light in which to handle the plates is a very deep green; but it is better to place them in the holders in total darkness, and to use a safe-light only for development, when, as we shall see, their sensitiveness can be so greatly destroyed as to allow of a comfortable light being used.

Next, in the dry state, the plates are much more than ordinarily sensitive to damage by finger-marks. They should be handled by the edges only, and on no account laid down with the film in contact with anything. This caution is all the more necessary, since the glass side of each plate requires to be cleaned before placing in the holder.

Last, in the wet condition, the surface of the plate is extremely soft and tender, almost sticky. A gelatine plate is as tough as leather in comparison with it. You musn't touch it with the finger and expect to see it undamaged. Any local treatment in the way of reduction, etc., must be done with absorbent cotton thoroughly wetted with the solution.

A word should be said on the keeping quality of the plates, since the makers mark each packet with a date indicating a period within which they should be used. As this date represents only four months from manufacture, it may easily have been reached by the time the plates get to non-European users, who may therefore think them unusable. In point of fact, as MM. Lumière themselves say, the plates keep much longer than this; under good conditions (away from heat and damp), for a year or more. General experience is that they are little inferior in this respect to other color-sensitive plates.

As regards the finished transparencies, varnishing supplies protection against physical damage; their permanence toward light is such that they will remain unchanged for years in ordinary indoor conditions, although the colors suffer by continuous exposure to strong daylight. And, even when varnished, the plates will not bear *long* exposure to a great degree of heat, such as that of a stereopticon. A not unusual result of over-heating is total disappearance of the colors, due, no doubt, to the emulsion shifting out of

register with the color-film through unequal contraction of the films.

Loading Plates The safest plan is to load the plate-holders in darkness, as can easily be done with a little system beforehand. First place the holders (and kits, if they are used) ready to hand. Then, unless you have previously hinged a card to each kit, place together the cards for backing up the plates. They are best laid black side down, this being the side which is placed next to the film. The plates are packed in pairs, film to film, with a thin paper between each, so that there is no difficulty in knowing the film side without touching. Then, holding a plate by its edges, carefully wipe the glass side with a clean piece of wash-leather, and lay in the holder, or kit, glass side outward. I prefer not to dust the film side at all—only to give the plate a smart rap on the bench to dislodge any chance particle of dirt; but the glass side should be well cleaned with chamois wash-leather, since particles of dust upon it are liable to cause black spots in the finished result.

Some workers, I know, prefer to load by a green safelight. No doubt this is quite safe if one is expeditious, and is careful to handle each plate so that the glass side is turned toward the light. The color-film stops a great deal of light; in fact, the Autochrome, when shielded by the color-film, is a slow plate, although sensitive to all colors. A skilled worker may handle it in fairly bright green, or even red light, without any evil effects, but my experience is that it is most satisfactory to load the holders without any light whatever. Fog at this stage will cause general flatness of the final transparency, if the light falls on the emulsion side of the plate, while fog caused by light coming *through* the color-film leads to a tint corresponding in color with that of the safelight.

Subjects The beginner in color-work usually cannot resist the temptation, for his first experiment, to collect a veritable feast of color in front of the camera. Natural curiosity overpowers him to "see what the plate will do," and therefore he crowds the gayest collection of flowers he

can get together against a background of vivid hue. The hideousness of the result is generally in direct proportion to the care which is bestowed upon the composition of the subject. Let the reader be persuaded to forswear these artificial triumphs, and to seek subjects as he does in ordinary landscape work, but with a sharpened sense of color values and masses. A whole monograph might be written on this part of our subject—perhaps some day I may attempt it,—but here I must advise the reader, whose aim is a pictorial one, to begin by seeking subjects in which colors harmonize, rather than those in which the effects impress one by their contrast. He is then far more likely to get results which will charm the beholder, not merely from the wonder of them, but strictly for their intrinsic beauty. Most of us are utter novices in color, just as we are novices in the tonal values of ordinary photographs. In color, the opportunities for committing artistic crimes are as many as in ordinary photography—nay, more numerous, and therefore I say, play for safety at first by looking for subjects without clashing colors, the ordinary landscape with trees in masses, a fairly heavy foreground and generous sky-area—for example.

Another hint on this choice of subject, and I will leave the reader to himself in this superlatively fascinating field. Seek also "bigness" in your subjects, i. e., masses of color rather than a lot of multicolor detail. Even when technically perfect, the color photograph suffers from the smallness of its size. For many of the subjects which are attempted in autochrome work, a painter would choose a big canvas, realizing that a facsimile on a reduced scale is not a facsimile at all as regards its effect on the human beholder. We cannot follow the painter in his choice of a large-scale picture, but we can mitigate the effect of reduction by discretion in the choice of the subject. As the outcome of making and examining Autochrome and other color transparencies for the past nine years, I believe that the above two hints embody a creed sufficient to save the color-worker from artistic damnation. And, having said that, let me turn to the next step in practical work, viz., exposure.

Exposure The speed of the autochrome plate is reckoned through the color-film on the glass and through the lens-filter. These two together make the plate a slow one in actual work. MM. Lumière indicate its speed by directing an exposure of one second in midday summer sunshine, with *f*/8 stop and for an average fairly near subject of not unduly strong character. This means that in working speed the plate is 60 to 100 times as slow as an extra-rapid ordinary plate. But, with the autochrome (with the Paget, too) it is necessary to give considerably more than the proportionately longer exposure when a small stop is used, or when the light is poor, due to the time of year or day, or to the exposure being made indoors or under trees. In other words, the plate is slower to a weak light than to a strong one, and it matters not whether it is the stop, the dullness of the sky, or the poor illumination, which causes a low intensity of light on the ground-glass. In bright light, with outdoor subjects and a large stop (the best conditions), the speed of the plate is 2 Watkins or 14 Wynne. An exposure-meter is a great help. The Watkins firm issues a special dial for the Bee meter, on which the extra-long times are indicated. I have found this meter very reliable in use, but with others similar provision may be made by taking a lower speed number as the light is poorer. Thus with the Wynne, use a speed number of 11 in diffused light, and 8 for exposures indoors or when the outside weather is dull; 14 in bright light. In addition to this factor, allowance requires to be made for the smaller stops. There is no need to trouble about these for *f*/8 and larger, but from *f*/11 downward a good rule is that of Biermann, viz., to give 2½ times the exposure for each reduction of the diaphragm which, in ordinary work, would mean doubling the exposure. Thus, if the light is such as to require 2 seconds at *f*/8, the exposure at *f*/11 should be 2½ times that, or 5 seconds; and at *f*/16, 2½ times again, or 12½ seconds. Practical familiarity with the factors governing exposure with ordinary plates is the best aid I can suggest for successful work with color plates.

A Working Exposure System

Thus I advise the reader to do one of two things: Either get a Watkins Bee meter, with color dial, and follow its indications; or use a Wynne meter, in the customary way, except that you choose a plate-speed of 14, 11 or 8, according to circumstances, *and*, if you use a medium or small stop, that you further increase the exposure (at $f/8$) by as many 2½-time steps as are called for. If $f/11$, this will be just 2½ times; if $f/16$, 6¼ times; if $f/22$, 15½ times; in each case in comparison with the $f/8$ exposure shown by the meter. But let me say, again, that dull light or small stops are things to be avoided in Autochrome work. It may be that our present knowledge of the correct exposure to give under these conditions is still incomplete. At any rate, general experience is overwhelming in showing the better quality of result as regards color-rendering, transparency, and that indefinable "richness" which is got with a large stop and bright light. As regards the character of the subject itself, this requires to be taken into account just as in ordinary photography. The exposures found by meter are for an average fairly near subject, and may be halved for an open landscape, or doubled (or more) if the foreground includes dark heavy masses.

Using a Large Stop

When it is found impossible to get the various parts of the subjects all into sharp focus without stopping down the lens, some part must, of course, be sacrificed; but a great deal can often be done by the use of the swing back, side-swing, or swing-front of the camera, to adjust matters so that near and distant objects can be sharply defined without resorting to a small stop. The most common dodge of this kind is to swing the camera back to the rear, so that the upper part of the focusing screen leans away from the lens. This helps to get the immediate foreground in sharp focus at the same time as the more distant parts of the subject. Tilting the lens downward has the same effect, the lens also requiring to be lowered on its front. In a similar manner, the side-swing of the camera back can often be used to get a near foreground object to the right or

left of the picture into focus at the same time as distance on the other side of the subject. These are dodges familiar to the old photographic hand, and my apology for mentioning them here is their special utility in color work out-of-doors.

The Dark-room Light

Autochrome plates are best developed as soon as possible after exposure. On tour, the process need be carried only so far as re-development, and any other manipulation left to the return home without any ill effects. The plates can be handled entirely without a dark-room, if one develops for a fixed time; but it is much better to be able to watch development, and, therefore, I refer here to the one or two points of real importance in the use of a dark-room. The chief of these is the safe-light, which should consist of several thicknesses of the yellow and green "Virida" papers, which MM. Lumière supply very cheaply. Two green and three yellow papers are enough for use with an oil lamp; more may be necessary for more intense lights, such as electric metal filament lamps. The papers are placed between two pieces of glass, which are bound together passe-partout fashion with a gummed strip. A brighter light can be used if the lamp is so placed that rays can reach the plate only by reflection, e. g., put the lamp on a shelf and handle the plate underneath it. This makes for greater comfort; but beware of any arrangement under which it is possible for such stronger light to fall directly on the plate.

Gentle Water Supply

Another very necessary precaution is to avoid any strong pressure of water from the faucet. The plates get several rinsings between the various baths, and such are better done under a stream of water than by rocking in a dish. The ideal plan—and a very simple one—is to stand a jar of water on a shelf a foot or two above the work-bench, and to lead the water from it by a siphon tube, with a rose jet and tap fitted to its lower end. The pressure from this small head of water is small, and cannot injure the delicate film, as the stronger force of water from the faucet might do. Prevention is better than cure in dealing with Autochrome plates.

A One-Dish Process The rest of the manipulative outfit is not formidable. Apart from the stock solutions, and one or two graduates, it consists of one dish. Autochromes are not plates to be dealt with in batches. Each should be carried through by itself, and the thinness of the film is such that with the most lengthy procedure half an hour is ample for the process from first to last. The best dish is one of glass. One can be sure that it is perfectly clean at the start, and it cannot absorb chemicals, as can one of porcelain ware in imperfect condition. Choose as shallow a dish as you can get; it is then easier to rinse the plate between each bath, without taking it from the dish, which is the right way to work. Frilling, which was a nuisance with many of the first batches of Autochromes, has been largely overcome by the makers; but it is still wise to avoid all unnecessary contact of the fingers with the wet plate.

Development The Autochrome is unlike any other plate in that the development is only a first step to the final result. The negative image is developed, and is then at once dissolved away by a powerful solution which, however, is without action on the emulsion unaffected by the development. Then comes "re-development," but, let us remember, of the original emulsion *minus* the negative image and thus producing a positive. If we bear the mechanism of this reversal in mind, we shall understand that excessive density in the first development (due to over-exposure) means a thin weak positive on re-development; and *vice versa* a weak negative, from under-exposure in the first instance, results in a dense, heavy positive. Similarly, anything which stops light affecting the plate in the camera, e. g., dirt on the glass at the time of exposure, leaves the emulsion untouched by the first developer, and so leads to a dense black spot in the re-developer—just the opposite of ordinary negative-making. If this inverted order of things be clearly recognized at the start, the beginner will be saved much unnecessary bewilderment at the effects of errors in exposure and development. These differences should be recognized.

Developer At the first introduction of the process, pyro was recommended for the first development and amidol for redevelopment. Many leading workers still prefer this to the simpler method with metoquinone, which reduces the number of stock solutions for this part of the process from 4 to 2. But I advise the beginner to start with metoquinone (quinomet), preferably buying the concentrated solution. If the developer is made up, I advise using twice the quantity of water and taking double as much in comparison with the purchased stock. This, for the reason that there is often some difficulty in getting the metoquinone to dissolve completely to form a full-strength stock. The half-strength formula is: Warm water, 70 ounces; metoquinone (quinomet), ½ ounce; soda sulphite, dry, 3½ ounces; liquor ammonia (920), 9 drams; potass. bromide, 90 grains. The water should be about 100° F. (about as hot as the hand can bear comfortably), the quinomet dissolved in it, then the sulphite and bromide, and then, when cold, the ammonia added. This stock solution will keep in good condition for a month or two. To make the working developer for a correct exposure, 1 part of the bought stock is mixed with 4 parts of water, or, if the half-strength stock, made up as above advised, is used, 2 parts with 3 parts of water. For a 5 x 7 plate use 5 ounces of the working solution, putting it in a graduate, to which it is returned for use in redevelopment. The only other bath required is the reversing solution.

The Reverser This is made up with potass. permanganate and sulphuric acid, each of which should be kept as a separate stock solution, and the reversing bath made at the time of use by mixing equal parts of each. The ready-mixed or used bath does not keep well, depositing brownish flakes which mark the film. The stock solutions are: *A*. Potass. permanganate, 35 grains; water, 20 ounces; *B*. Sulphuric acid, concentrated, 3 drams fluid; water, 20 ounces. In making these solutions, use warm water for the permanganate, and make sure that every particle is dissolved. In making *B*, note that sulphuric

acid is a highly corrosive liquid. It should be added to the water (cold) not *vice versa.* The working solution is made by mixing equal parts of *A* and *B*, the mixture corresponding with the Lumière *C* solution, to which reference will often be found in articles and booklets on the process. For the treatment of a plate, 3 or 4 ounces of the mixed reverser is placed to hand in a graduate, and we are then ready to begin.

Developing Owing to its very thin film, the autochrome plate develops quickly. If exposure is about correct, development is complete in 2½ minutes. The usual mistake is to over-develop, therefore it is a good plan to check the time by a watch or, better, a clock such as the Eastman Timer, with a bold dial, which can be plainly seen in the dim green light. For the same reason, wait a minute or two, before beginning operations, for the eyes to get accustomed to the faint light. Handle the plate as far as possible from the light, flooding on the developer with an even sweep over the plate, and immediately covering the dish with a card. After about half a minute, you can take a look at it as it lies in the dish. If, with approximately correct exposure, the image should be plainly visible. The color-sensitiveness of the plate is now greatly reduced, and there is no harm in leaving it uncovered. In now judging the progress of development, forget all your preconceived ideas of what a negative should look like. The autochrome is judged by looking at it, not through it. In fact, it should not be taken from the dish at all until ready to be dried. The plate should be allowed to gain strength in the developer until there is a slight gray deposit over even the heavy shadows, whilst only the extreme high-lights look black. When it is done, it should have pretty much the appearance of a negative on an ordinary plate which has been under-exposed and fully developed; that is to say, there should be no tendency for the detail to be buried in general density; it should all be there plainly visible as the plate lies in the dish. Positive under-exposure is shown by only the highest lights coming up on the plate, whilst over-exposure may be recognized by the growth of density.

Over-Development One effect of over-development is hardness of result; the final transparency is thin, but has the harsh appearance of a print from a hard ordinary negative, tending to a crude-looking color-rendering. A further evil from the same cause is pinkiness of the high-lights, such as the sky. A moment's thought will show how this comes about. If you take a spoilt Autochrome and rub off the emulsion film, you will see that the color-coating is not pure gray, as it should be in an ideal screen-plate, but pinkish. If you develop too thoroughly, the highest lights of the subject are reduced right through the very thin emulsion and, on dissolving the deposit away in the reverser, the pinkish color-film is left bare. Re-development does nothing to improve matters, because there is no undeveloped emulsion left. This eating-out action of excessive development is very pronounced. With less development, the high-lights, after reversal, are left covered with a thin deposit, which serves to mask the pink coloration of the screen itself. This it does through the correct adjustment of the lens-filter to the plate. The filter is made so as to provide a corrective for the tint of the color-film, but, as I have just shown, its action is made of no effect if the plate is so fully developed as to leave the high-lights entirely destitute of deposit after reversal. From which it will be seen that a great part of the art of developing autochromes consists in getting sufficient general detail and gradation, whilst avoiding this excessive density in the high-lights.

Biermann's Methods In this connection, I quote here the methods for the use of the metoquinone developer recommended by Mr. E. A. Biermann, whose very fine Autochrome work is done as a branch of his three-color engraving business. Instead of sticking to the standard strength of the developer, use it weaker except for subjects in very dull light. Thus, for subjects in bright sunshine, the Lumière full-strength stock solution is mixed with 8 times its bulk of water, or 10 times if the subject is very brightly lighted. If sunshine, either direct or diffused, is absent, a strength of 1 part stock to 6 parts

of water is adopted, and the normal 1-in-4 strength used only for known under-exposures, subjects in very dull light, or interiors without windows showing in the picture. As regards the time of development, Mr. Biermann has a rule of his own, for use with developer of any strength. Working in the green safelight, he pours on the developer and starts counting seconds. At the first sign of an image, not reckoning the sky in outdoor subjects, a note is made of the number of seconds and the dish is covered. Then the full time of development is found by multiplying this time of appearance by itself and then by 4. Thus, if image appears in 6 seconds, time is $6 \times 6 \times 4 = 144$ seconds, or 2 minutes 24 seconds, seen from a table of appearance-times of from 2 to 15 seconds. If the image does not appear in 15 seconds, the plate is under-exposed, and it is best to strengthen developer to 1-in-4 and develop the plate for 15 minutes.

Washing

I shall return to other development methods directly, but now I will pursue the straightforward process which I recommend the beginner to adopt. When development is judged sufficient, pour off the solution into the graduate for use again, and at once rinse the plate for one minute. The best way to do this is to hold the dish at an angle, under a gentle stream of water, so that the water runs off, as it will do from a shallow dish. Soaking the plate in water helps to produce frilling of the film, if there is any tendency that way. In that case, a good plan is to replace the developer with saturated solution of alum, immerse the plate for two minutes, and then rinse before proceeding to the reversing process.

Reversing

After this brief rinse, the reversing bath is poured over the plate, which may then be taken out of the dark-room and completed in full light. Three or four minutes is ample for the reverser to act. It is then poured back into a graduate, if other plates are to be treated; if not, it is thrown away. At this stage, the color-transparency first becomes visible (on holding the glass dish over a sheet of white paper), but much weaker and flatter than it subsequently appears on re-development.

The next step is to rinse the plate, in the way already directed, for half a minute before proceeding to re-develop.

Before leaving the reversing bath, it may be mentioned that some workers have preferred bichromate to the usual permanganate formula. A formula is: Potass. bichromate, 30 grains; sulphuric acid, 1 dram; water, 15 ounces. This solution keeps indefinitely, but in other respects is not better than the permanganate, except, perhaps, as a means of avoiding green spots, of which more will be said later.

Re-Development

When the metoquinone developer is used for the first development, the solution does again for re-development. In Biermann's method also the weaker developer, at all strengths from 1:6 to 1:10, is quite satisfactory for redevelopment. In this latter operation, the two important points are: (1) To expose the plate to weak daylight or strong artificial light before applying the developer, and (2) to allow ample time (4 minutes) for full action of solution. Without exposure to light the white image will not darken fully in the developer. If one is working by daylight, the illumination which the plate receives whilst being rinsed and whilst in the re-developer is usually enough. Strong sunlight is best avoided. At night, stand up the dish containing the plate and burn 3 inches of magnesium ribbon at about 6 inches' distance, or expose for a minute or so a few inches from a 50-candle-power electric bulb.

As regards the action of the re-developer, this must be thorough. It is not enough to keep the re-developer on only until the plate appears to have darkened completely. That will probably leave a certain amount of unreduced silver bromide in the film, leading to loss of vigor if a fixing bath is afterwards used. In the process so far described in these pages, no fixing bath is needed. The reverser removes one part of the silver compounds and the re-developer reduces what is left; but, if the plate is intensified, it is then necessary to fix for the sake of permanence.

After about 4 minutes in the re-developer, the plate is rinsed for 3 to 4 minutes. If this longer rinse is not

done in the dish (tilted for the water to run off), the next best plan is to lay the plate face up on a good-sized graduate, or better a block of wood, and let a soft stream of water run over the surface for the prescribed time—not longer.

At this stage, if all has gone well, we have the finished transparency, save for drying and varnishing. It should be clear and brilliant. If too thin and weak in coloring from over-exposure, it can easily be improved by intensification. If muddy and dark from under-exposure, something, though not very much, can be done to remedy matters by reduction. We will postpone these processes for a while in order to refer to other developers and methods of development; but must first say a word on drying and varnishing the Autochrome, which, of course, calls for no further chemical treatment.

Drying

Although the Autochrome plate, owing to its very thin film, dries in an hour or so in the ordinary way, it is just as well to assist matters by whirling it before standing it aside. This gets rid of all adhering water in the only possible way—for the film cannot be mopped—and avoids scum markings from tap-water. Some workers have improvised efficient whirlers by attaching a good-sized rubber bulb—the pneumatic holder of wet-plate days—to an egg whisk. The commercial whirler made for process workers can be obtained from dealers. A whirler is a most useful thing to have at hand if plates frill; for it is most efficient in checking the defect as soon as there are signs of it, whirling the plate until quite dry, which will be in a minute or so. Means can then be taken to prevent the frilling spreading, although the rapid drying is often enough of itself to obviate the difficulty.

Varnishing

The transparencies gain distinctly in clearness and brilliance by being varnished, but, apart from this, varnishing should always be done for the protection of the delicate film against damp or accidental damage and, in the case of lantern slides, as some preventive of damage by heat. The varnish must not contain spirit (alcohol),

which dissolves the coating, separating the color-film from the emulsion, and so loosens the latter. Gum dammar, 1 ounce, dissolved in 10 ounces of pure benzole, is a good varnish, and I believe that supplied by Lumière is of this kind. Celluloid varnish, if free from spirit, is just as good and is easily made by soaking clean strips of celluloid in amyl acetate until no more will dissolve, although it is better to buy a reliable varnish ready-made than incur the mess and trouble of making it. It is used cold, pouring a liberal quantity on to the middle of the plate, which should previously have been very carefully wiped with a soft silk handkerchief, rolled up to a pad, in order to remove all particles of dust. The varnish readily flows to the corners, on tilting the plate slightly, and the excess is drained off from the last corner to a second bottle, keeping the angle of the plate moving to and fro in the bottle neck as long as any drops fall, and so avoiding streaks in the coating. If you have a whirler, put the plate on it at once; the coating will then dry quickly and evenly, and has not so long to pick up dust. But fix some kind of screen around, e. g., a cardboard hatbox, to catch the varnish which is thrown off. If not whirled, simply stand the plate on one side somewhere, where no positive heat can come to it. When the coating is dry and hard, any varnish which has got on to the glass-side can be cleaned off with a rag just moistened with gasoline.

The Pyro Developer

Now I retrace my steps in order to say something on developers other than metoquinone which can be used with advantage. As originally introduced, the Autochrome process included pyro as the first developer, amidol as the re-developer, with intensification as an indispensable after-treatment, involving a formidable series of seven successive operations, not reckoning the same number of rinsings, and calling altogether for nine stock solutions or baths. By the introduction of the metoquinone developer these latter have been reduced to three, which is an undoubted boon so far as convenience is concerned, but, on the other hand, does certainly involve a lesser degree of control over the

result when the exposure has not been practically correct. On this account, and apart from the practice of always giving at any rate some intensification—leading workers have vigorously disagreed upon this point—pyro is still preferred by many skilled Autochromists, both in France and in England. Results do certainly justify the preference, and therefore I include here a formula, that of Mr. Jas. A. Sinclair, one of the first English workers to show technically faultless Autochromes. Stock solutions: *A*. Water, 10 ounces; potass. metabisulphite, 5 grains; (or soda bisulphite lye, 5 drops); pyro, 160 grains. *B*. Liquor ammonia, ·880, 400 minims; potass. bromide, 135 grains; water, 8 ounces. To make the working developer, mix ½ ounce of *A* with 5 ounces of water, and measure ½ ounce of *B* in a separate graduate, adding it to the diluted pyro stock immediately before use. The developer must be used for one plate only.

Developing in Ample Light

A method of comfortable working, which some leading workers have used, is that suggested by Dr. Drake-Brockman, viz., to give the plate a preliminary minute (*in total darkness*) in a bath of potassium metabisulphite, 130 grains, in 10 ounces of water. This treatment very largely destroys the color-sensitiveness of the plate, allowing of the development then being done in a fairly bright red light. The plate must be washed for about a minute on removal from the metabisulphite bath, and may then be developed with pyro, metoquinone or other developer. Probably, any developing solution has a great effect in reducing color-sensitiveness, but the advantage of Dr. Drake-Brockman's system is that you start development with ample illumination, and thus are able to judge more readily of the appearance of the image at the most important stage of the process, though you should still avoid unnecessary exposure of the plate.

Dillaye's Method

A modification of this plan has been worked out by M. Dillaye, who uses a mixed bath of soda bisulphite and potass. bromide. The latter is for the purpose of restraining the action of the developer, and so enabling

it to deal better with shadow detail, which, from the fact that the plate is exposed glass-side to the lens, is formed chiefly in the lower part of the sensitive film. The formula for the bath is: Potass. bromide, 100 grains; soda bisulphite lye, 3 drams; water, 20 ounces. The plate is kept in this (in total darkness) for two minutes, with constant rocking, then rinsed (in red light but with as little exposure to it as possible), and developed in the usual way with metoquinone, Lumière formula. This method is similar in effect to the use of weaker-working developer, as directed by Biermann, and is well suited to subjects of great contrast under bright lighting.

Other Re-Developers While the metoquinone used for the first development is quite satisfactory, as the re-developer and saves multiplying solutions, pyro, as I have said, cannot be used for this purpose. With this latter, amidol is the best re-developer. The exact formula does not matter particularly; any strong amidol developer containing about 4 grains of amidol and 20 grains soda sulphite cryst, per ounce of water, with no bromide, answers well, and is preferable to an alkaline developer, if plates give trouble in the form of frilling. Rodinal, of strength 1 part mixed with 20 parts of water, is another convenient re-developer.

Intensification In the early days of the process, it was the custom to intensify every plate. MM. Lumière so directed, but many of the Autochromes of the first few years were faulty from over-intensification, the effect of which is to make the transparency of excessive density, and at the same time to render the colors harsh and wanting in luminosity. Gradually it has become recognized that intensification will effect no improvement, but the reverse, in a properly exposed and developed plate, and that, even when some intensification is called for, it is better to do too little rather than too much of it, and so to avoid garish color-rendering. A good deal depends on how the first part of the process is carried out. If exposure is full, and the first development moderate, the result is one which requires a fair amount of intensification to

give brilliance in the final transparency. On the other hand, with shorter exposure and normal development, there is less call for intensification. The former plan is the safer, for in development we must rely on judgment and experience in gauging the effect, whereas in intensification we see the action taking place. This is particularly so in Autochrome transparencies for lantern projection, which require to be both thin and brilliant, a result which is gotten by full exposure, fairly full development, and intensification *quant suff.*

The Intensifier

Although various intensifiers, such as chromium, mercuric iodide, mercury ammonia, and "Agfa" can be used, there is none which is at once so suitable for the purpose, or so satisfactory as regards permanency, as that originally directed by MM. Lumière, viz., an acid mixture of pyro and silver nitrate. The process is carried out on the plate after re-development, and calls for five solutions, three of which, *F*, *G* and *I* are kept at stock, whilst the other two, *E* and *H* are made up at the time. I use here the letters adopted by MM. Lumière, since in much that is written on the autochrome process the solutions are referred to only by letter. First, the stock solutions:

F—Pyro, 25 grains; citric acid, 25 grains; water, distilled, 20 ounces. This keeps badly, owing to a fungus growing in it. The addition of 40 grains of salicylic acid to the formula will avoid this, in which case, dissolve the salicylic acid in 2 ounces of hot water; and add to the remaining 18 ounces, after the other chemicals have been dissolved in the latter.

G—Silver nitrate, 90 grains; water, distilled, 4 ounces.

I—(Fixing Bath)—Hypo, 3 ounces; soda bisulphite lye, 1 ounce (fluid); water, 20 ounces.

The two solutions to be made up at the time of use are:

E (Oxidizer)—Permanganate reversing bath (working mixture of *A* and *B*, as given on p. 111), ½ ounce; water, 25 ounces. This is used for destroying all re-developer left in the film.

H (Clearer)—Stock permanganate, *A* solution as given on page 111, 1 ounce; water, 3 ounces. This is for the removal of any yellowish stains from the intensifier.

N. B.—These two solutions must not be confused. *E* is acid and, if used in place of *H*, would partly remove intensification. *H* is non-acid and would be ineffective for destroying re-developer.

Intensifying First rinse the plate, after re-development, for half a minute under the faucet, and then flow on an ounce or two of solution *E*, keeping it in movement for 10 to 15 seconds. Longer than this will weaken the colors. The *E* solution may be used at times with advantage in modifying results of too great strength. But in the ordinary way it should not act for longer than 15 seconds, and should retain its pink color for this time. Then drain it off, rinse the plate for a few seconds under the faucet, let all water drain from the glass dish, and mix the intensifier in a clean glass, graduate by adding 3 drams of *G* to 4 ounces of *F*. Keep this mixture in movement over the plate until sufficient intensification is obtained. The intensifier acts fairly quickly—in 1 to 3 minutes—gradually darkening and becoming slightly turbid. If it is seen to be becoming slightly muddy in appearance, whilst the plate is not sufficiently intensified, it is best to mix a fresh lot and apply again, after first rinsing the plate and treating it for a moment again in *E* solution, followed by a brief rinse. But it will seldom be found that more than one dose of intensifier is needed.

The next step is to rinse for a full half-minute, and then to flow over the non-acid permanganate bath *H*, and allow it to act for a minute. This is to remove the yellowish tint over the high-lights, which is left by the intensifier. Then rinse again for a full half-minute, followed by 2 minutes in the hypo bath *I*. A final rinsing of 5 minutes suffices to remove the hypo, and to leave the plate in readiness for drying.

Though these operations appear tedious in print, they are very quickly carried out, the whole process occupying less than a quarter of an hour.

Failures and Defects And now, having covered the ground so far as the making of an autochrome ready for binding to its cover-glass is concerned, we may briefly make a few notes of the chief defects which the finished result is liable to have.

Black Spots These are caused by dirt on the glass-side of the plate at the time of exposure, by air-bells on the plate during the first development, or by particles of undissolved amidol in the re-developer. The spot, in each case, consists of silver deposit, and can be removed by touching (on the dry plate) with a very small soft brush, moistened with the reversing bath, or with a solution of 15 grains iodine and 25 grains potass. iodide in 2 ounces of water. After applying the iodine, the plate is dipped for a moment in the fixing bath, *I*, and then rinsed for 5 minutes. Dr. D'Arcy Power touches such spots with sulphide-toning bleach, followed by hypo, which removes the spot entirely, and allows the plate, when dry, to be spotted to match the ground; or in many cases he finds it sufficient to touch the bleached spot with 2½ per cent sulphide bath (after washing one minute), the resulting brown spot being inconspicuous.

Green Spots Green spots or scratches are due to the varnish protecting the color-film being perforated, e. g., by dust between plate and backing card, or pressure of springs of plate-holder. The only remedy (a poor one) is to cut out the spot with a fine scalpel through to the glass, and then to fill in with albumen, retouching color after applying a touch of varnish. Some authorities have declared the bichromate reverser (page 115) to be superior to permanganate as regards freedom from green spots, but the only real preventive is to avoid all rubbing of any kind against the emulsion film coupled with development as soon as possible after exposure.

Pink Veil Pinkishness of the whole subject is the result of over-exposure, supplemented by over-development. In some cases, this effect seems to be due to undue action through the red grains of the color-film; in others, as we have seen, to the color-film being entirely bared of silver deposit in the reversing bath.

Blue Veil Bluishness, on the other hand, is due to leakage of white light through the lens, to under-exposure, or to the use of a light-filter other than that supplied for plates.

Both these general hues, if only slight, can be corrected fairly satisfactorily by tinting the whole autochrome either by a weak-dye bath, or better, by a tinted film, as mentioned in a later paragraph (page 126) for projection purposes.

Minor Faults Bluishness of the greens is a common defect with beginners, and is due to under-exposure, followed by over-intensification.

Loss of strength and general weakening of the colors in the fixing bath, is due to incomplete re-development. The re-developer must act for a full four minutes, not merely until the plate seems fully darkened on the surface.

General darkness and density of the transparency arise from under-exposure, or under-development. The plate can be reduced in solution *E*, or one containing ¾ to 1 ounce of the reversing bath in 25 ounces of water, afterward intensifying slightly, if the result is somewhat flat in appearance.

Last, we come to frilling, which deserves a paragraph to itself as a serious difficulty.

Frilling Those of us who used the Autochrome plates at the first will never forget the trouble required to keep the emulsion film from puckering up around the edges, or even leaving the plate altogether. This defect has been largely removed by the makers, but, from the nature of the plate, it is bound to arise more easily than with ordinary plates. If encountered now, it is usually in a much milder form, which does not call for the drastic measures, such as edging with wax or binding with surgical tape, which we used seven or eight years ago. Now, a generally sufficient preventive is to use a chrome-alum bath of strength 90 grains in 20 ounces of water for a minute after rinsing from the reversing solution, again rinsing and re-developing as usual, but preferably with amidol. Another plan is to rinse the plate quickly after the reverser, and then to whirl it dry before proceeding to re-develop. It hardly need be said that the developing and other solutions, as also the wash-water, should not be above 65°. When

working in hot countries, where ice cannot be had, it is necessary to develop late at night, or in the early hours of the morning.

Viewing Autochromes Before passing to some by-paths of Autochromy, the chief of which are stereoscopic and flashlight work, extra-sensitising the plates for more rapid exposures, and the making of transparencies in duplicate, I may bring these notes on the regular process to an end by dealing with the showing of larger Autochromes, and the projection of the smaller ones. Daylight is the light by which to view an Autochrome. By no other does it show the full perfection of its color-rendering, except by the aid of more or less elaborate means to bring the illumination into correspondence with daylight. For the viewing of a single transparency, there is no more convenient appliance than the so-called "Diascope," viz., a frame in which the plate is held, so that one is able to look at its reflection in a mirror. It is simply the usual pattern of re-touching desk turned back to front, with a mirror laid on the baseboard, and with the autochrome placed in the holder for the negative. This arrangement allows one to examine the transparency at ease when seated at a table, whilst the plate, owing to its inclined position, gets the best light in a room, viz., that coming through the upper part of the window. Moreover, when the frame is closed, the Autochrome is protected on each slide.

The showing of autochromes in number at an exhibition is not such an easy matter, for it is almost always necessary to provide artificial light for the evenings. One plan is to set apart a darkened room, and either to erect an upright partition in it for the support of the transparencies, or to provide a big rectangular frame-work for the same purpose. In the one case, the lights are placed behind the partition; in the other, within the frame, every atom of space between the transparencies being blocked up with stiff black paper. The lights may be three or four open arcs, or high-power nitrogen bulbs, or a much larger number of ordinary metal-filament lamps of fifty-candle power. Whichever is used, a diffusing screen of ground glass

requires to be placed about two or three inches back from the Autochromes, and further diffusion of the light obtained by having the floor of the chamber white. I have found this mixture of reflected and direct light to work well with both arcs and incandescent bulbs. With the latter, it is well to attach a very pale blue tissue paper to the ground glasses, in order to counteract the greater yellowness of the light; otherwise the lighter tones of blue in the transparencies show very poorly, and yellows tend to disappear. At the exhibitions of the Royal Photographic Society, the Autochromes are shown on the Diascope system in frames about twelve feet in length, and of depth to accommodate two rows of 5 x 7 plates. In the daytime, the light from the roof of the gallery is used—incandescent gas, after dark,—and the result in both conditions is excellent. One final hint may be given on showing collections of Autochromes, and that is to isolate each as widely from its neighbors as is possible. Each gains immensely in brilliancy and effect by an ample surrounding of darkness.

Projection A high-power illuminant, such as an arc-lamp or oxy-hydrogen jet, is necessary for showing Autochromes effectively on the screen, on a scale of 6 to 10 or 12 feet from a three-inch transparency. Such strong lights heat the slide considerably, and it is necessary not to keep it in the lantern longer than about half a minute, otherwise the color may be entirely destroyed. A glass trough filled with water cuts down the heat of the light considerably, and allows of a longer period. It is usually fitted between the condenser and the slide carrier, although one British maker, Messrs. Beard, puts it between the lenses of the condenser and further connects it to a water reservoir above, by which the water in the cell is kept cool on the thermo-siphon principle adopted for motor-car radiators. But equally important is the openness of the lantern-stage. In many lanterns, the slide is kept boxed-in to such an extent that the stage is virtually an oven. For autochromes, in particular, the stage needs to be open, top, bottom, and sides, so that there is a clear air-

space of four or five inches in width in the side facing the light. This again helps immensely to keep the transparency cool, and is adopted in many up-to-date stereopticons.

The screen also requires to be of the best, preferably painted in zinc white on a solid wall, or, failing that, one of the opaque screens sold by the dealers in lantern requisites. A "silver screen," i. e., one coated with aluminum paint, gives a very much brighter picture, and is suitable for smaller audiences where usually a light of moderate power is used.

A hint may not be out of place in reference to lantern shows where Autochromes alternate with ordinary lantern-slides. In contrast with the brilliant projection of the usual diapositives, the Autochrome looks exceedingly dull, although, after one or two have been shown, the dull appearance ceases to be noticeable, since one's eye accommodates itself to the lesser intensity. For this reason, when passing from an ordinary to an Autochrome slide, it is a good plan to interpose a brief period of complete darkness on the screen, which is most conveniently done by placing perfectly opaque dummy slides in the required places, explaining their object to the operator. This saves the abrupt change, and gives each Autochrome a chance to produce its full effect on the screen.

Tinters

As I have already said, a slight general tint over a color-transparency (Autochrome or Paget) can be largely corrected with a light tinting-glass, complementary in color to the hue which is in excess in the transparency. Thus, if the latter is too blue, we want a pale yellow tinter; if too red, a pale green; if too orange, a pale blue. The tinters require to be very pale, otherwise the other colors are affected, and the transparency made too dark as a whole. It is advisable to make a stock of a dozen or so by soaking old negatives in water, clearing away the image in the hypo-ferricyanide reducer, and well washing. The clear gelatine plates can then by dyed up in a bath of one or other of the dyes sold cheaply in packets for domestic use. From half to two grains of dye per ounce of water is

strong enough. Use distilled or rain water, otherwise the tint may be scummy from lime in the water. Ten or twenty seconds usually suffices for a useful depth of tint, after which the plate is rinsed for a moment in plain water, and put aside to dry. With a few of these tinters at hand, one can try out their effect on a transparency which is too bluish or pinkish, and pick out one which will make a very marked improvement. The tinting glass is then simply bound up in place of a plain cover glass.

Tinters for Projection The yellowishness of all artificial lights in comparison with daylight makes it advisable to use a pale blue filter, in order to secure the best results on the screen. As in viewing transparencies, you then get a better rendering of the yellows. The tinter can be made as described in the previous paragraph, simply binding its edges with a gummed strip and using it in the lantern stage. For practical purposes, it is sufficient to make one or two and see which gives the best average result, although Von Hübl has given the following formula for a blue tinter to be used with electric arc: A mixture (warm) is made of 10 parts 1:15 gelatine solution; 1 part 1:1000 solution patent blue; 1 part 1:100 solution Rose Bengal, and 7½ parts of water. This is flowed on to glass in the proportion of 80 to 100 minims for every 16 square inches of glass.

Stereo Work In stereoscopic work on the Autochrome plates, it is necessary either to use two separate plates or to cut the finished transparency bearing both pictures on the one plate. It won't do simply to turn the uncut one-plate transparency glass side to the lenses or prisms of the stereoscope. Therefore, of the two alternative plans, one must be chosen, preferably the use of a single plate, which is cut in half when finished, and the halves transposed in the usual way, and bound to a cover glass. The plates are supplied in the standard stereoscopic size of 6¾ x 3¼ inches, as also in the 45 x 107mm. size for special stereoscopic cameras. Of the two, the larger size is to be preferred, as the color grain of the Autochrome becomes very pronounced when the trans-

parency is subjected to the considerable magnification which it gets in stereoscopes made for the pocket stereo-camera slides. For details of lens-separation and mounting and masking the finished transparencies, I must refer the reader to THE PHOTO-MINIATURE, No. 98. The rules there given apply equally to results on autochrome plates.

Flashlight Portraits

Indoor portraits are about the most difficult of subjects for the Autochrome plate, on account of the great length of exposure, but by means of flash powder an instantaneous exposure can be given and supremely beautiful results obtained. In fact, no finer Autochromes have ever been made than those by Mr. J. W. Allison, of Allison & Hadaway, New York, with this firm's "Panchroma" flash powder. In flashlight work, a special lens-filter must be used; that employed for daylight will not do. The makers of Panchroma supply filters for use with their flashpowder. As regards the arrangement of flashpan, sitter, and camera, the light should be placed about five feet from the sitter, and a little to one side or other of the camera, which directly faces the sitter. There should be plenty of reflected light. If a small room (about 5 x 7 feet) with white walls can be found, well and good; but usually it is necessary to make a room of this kind by means of white screens, not forgetting one about thirty inches wide about three feet above the sitter, so as to form a white shelf extending before and behind the sitter. Hints on the management of the light and the quantity of powder to use will be found in the instructions issued by the manufacturers of color-plates and special flashpowders used in this work.

Extra-Sensitising

By means of a dye bath worked out by M. Ch. Simmen, and supplied by the Lumière Co., the speed of the Autochrome plates can be increased about five times, and snapshot exposures of about 1/25 of a second can thus be given with an $f/4.5$ lens. I need not give instructions for the use of the bath, as these are fully detailed in the Lumière instructions. A special lens-filter is required for use with the extra-sensitized plates, and is supplied

by the Lumière Co., as are also others for use when employing the bathed plates by flashlight.

Copies of Autochromes

Although the one transparency obtained is (at its best) of beautiful quality, the Autochrome process is not one which naturally lends itself readily to the making of several duplicates from one exposure. Although at first sight it seems a simple matter to print from one autochrome on to another of the plates by contact, and to pass the copy through the regular process of development, reversal, etc., the result is unsatisfactory as regards sharpness and color-rendering, unless special precautions are taken, and even then the copy is never equal to the original. The most satisfactory method of all is to make the original as a negative transparency (i. e., in complementary colors) by development, fixing and, if necessary, intensification, without reversal. But, as a rule, one wants to make copies only of specially fine Autochromes, and therefore the process resolves itself into working from a positive color-transparency onto a second Autochrome plate and developing, etc., in much the same way as for an original. About the handiest way of doing this is to fix the Autochrome close in front of a condenser, and to illuminate it by incandescent gas or acetylene. In order to avoid overheating of the Autochrome, it is best *not* to use an enlarging lantern, but to rig up a support for the condenser, and to put the transparency so that air can reach it freely on all sides. As handy a way as any is to fix it at the back of a good-sized camera, the lens panel of which is removed and the lens of a smaller camera pointed through it, so as to copy the original on the required scale. This lens must be fitted with a filter made for whichever light is used. Exposures will range from 30 seconds to several minutes. They should be full, and the plates developed with the Lumière metoquinone of rather weaker strength, say 1:6 or 1:8, instead of 1:4, adding a little full-strength stock after the image has appeared. If a negative transparency is used, exactly the same plan is followed, except of course, that the plate requires no reversal or redevelopment.

The Paget Process

In a previous paragraph (page 99) I have briefly described wherein the Paget process differs from the autochrome, whilst in No. 128 of The Photo-Miniature the reader will find an account of the distinct forms of the process devised by the Paget Prize Plate Co., Watford, England. At present the materials for only one of these are on the market, and are obtainable in this country from the Herbert & Huesgen Co., New York. This is the so-called "duplicating" process, according to which any number of color-transparencies may be made from a single negative.

The Taking Screen

The starting point is the taking screen made up of minute rectangular red, green, and blue-violet areas, each about 1/300 of an inch. The panchromatic plate is exposed film to film with this taking screen and through the latter, the extra blue-sensitiveness of the plate being corrected by the use of a yellow filter on the lens, as in the Autochrome process. All that has been said in regard to the fitting of the lens-filter, and to the reversal of the ground-glass, applies equally in the Paget process, except that the special Paget filter and Paget plate must be used, and that it is the thickness of the taking screen, and not of the sensitive plate, which must be taken into account. It is most important that the plate be pressed into firm contact with the taking screen, for which reason the British book pattern of plate-holder is certainly preferable to any other. Even with these, a difficulty is the thickness of two glass plates, instead of one, in each part of the holder; but this, if it arises, is surmounted by using the taking screens and plates prepared on extra-thin glass, which are issued by the Paget Company. These will be found best also for use in American solid-pattern plate-holders, the construction of which allows of satisfactory contact between the two surfaces. If this is not secured all over, the result is wrong color-rendering, or entire absence of color in parts. If possible, put the taking screens into the holders in daylight, so as to be certain that they are correctly placed, i. e., glass-side toward the lens.

The taking screen requires to be taken care of in the way of keeping it from getting scratched, and from exposure to light. If that is done, one will last for hundreds of exposures. Anyway, the cost is not great, and it is best to get a supply according to the number of plate-holders, with one or two extra to have at hand in case of accidents.

Loading Holders

The Paget panchromatic plates on which the exposures are made must be handled in darkness, or in a green safe-light. The Paget Company supply special safelights, or I have found that the Virida papers (three yellows and two greens with a 16-candle-power bulb) yield a suitable illumination for both loading and development. The glass side of each taking screen is carefully cleaned, and the coated side, as also that of the plate, wiped free from dust with a bit of soft cotton velvet, remembering that the most perfect contact between the two surfaces is a *sine qua non* in the process. For this reason, see that the springs of the book-form plate-holder give firm pressure, using, if necessary, a sheet of black card behind the plate.

Exposure

The speed of the plates, through taking screen and lens-filter, is 12 Watkins or 18 Wynne, that is about three times that of the Autochrome, which is fast enough for slow shutter exposures in the best outdoor light and with a lens of *f*/6 or, better, of *f*/4.5 aperture. As with the Autochrome, the exposure requires to be longer than the regular proportion when the light is dull, or a small stop is used. I will not say that this necessity is so marked with Paget plates as with the autochrome. It is, however, a very safe plan to follow the rules already given for the autochrome, but reducing exposure to one-third. It is better to err on the side of over- than under-exposure, for the ideal negative is one which is soft and thin, with the detail of the pattern of the taking screen throughout all the tones.

Development

A soft-working developer must be used. Rodinal, of strength 1 part in 30 parts of water, answers well, development being complete in two minutes at 65° F. It is

quite satisfactory to work by time in darkness, but, if you use the green safelight, keep the plate covered as much as possible. After a brief rinse, the plate is fixed in an acid bath of: Hypo, 6 ounces; potass. metabisulphite, ½ ounce; water, 20 ounces; and when washed and dried is ready for printing.

The Positive Transparency Diapositive plates are supplied by the Paget Company. They are similar to lantern plates, but give an image of specially intense black tone and brilliance. They are handled just like lantern plates, that is in bright orange light. First examine the negative, to see that the emulsion has not formed raised ridges round the edge, as it may do through handling with the fingers when wet. If the edge is not perfectly smooth and even all around, it is best to cut and scrape away a strip about one-eighth of an inch all around with a sharp penknife; any minute lumps of the edge will interfere with proper contact of the positive plate. Also use a printing-frame with strong springs, pushing the negative and the positive both into one corner. This keeps the sides of the two plates parallel, and facilitates the registration of the positive with the viewing screen. Exposure is short—about five seconds at three feet from a sixteen-candle-power electric carbon-filament lamp, but one can often place the frame farther away with advantage, the longer exposure then allowing of parts of the negative being shaded during printing.

Developing the Positive This is perhaps the stage of the Paget process in which beginners find some difficulty. The transparency is unlike an ordinary lantern-slide in the fact that it has the pattern of the taking screen running all through it, and this pattern requires to be sharply rendered in the diapositive as opaque deposit, in order to give good color-rendering. The special developer supplied by the Paget Company is the best I have used, but a hydroquinone formula made up with caustic soda works very well. Keep the solution in movement for the whole time of development, and use a fresh lot of developer for each plate. The plate must be developed to greater brilliance and density than is right for ordinary lantern-

slides, otherwise the color effect will be weak. A good guide is the appearance on the back; detail in the shadows should be just distinctly visible. When this stage is reached, fix at once in the acid hypo bath, given above for the negative plates, and wash and dry.

Registration

Now comes the last stage in the process, viz., binding up in register with the viewing screen. Here, again, see that there is no ridge of wrinkled film on the edge of the positive plate, as already directed for the negative. The next thing is to provide a source of light which is low down, and so saves one the fatigue of holding the plates up and out at arm's length when adjusting one or the other. I get any kind of box, lay a sheet of ground glass on the top, and rig up a fifty-candle-power bulb just below it. Set the box on the floor, and seat yourself beside it. Then with the elbows supported on the knees, you can handle the glasses comfortably over the light. If you use the square ($3\frac{1}{4} \times 3\frac{1}{4}$ inch) positive plates (the standard English lantern size) and viewing screens to match, you require to notice the scratch on the film along one side of the latter. The side bearing this scratch must be in alignment with the side of the diapositive which was in contact with one of the longer sides of the negative when printing. In the case of 3×4, or quarter-plate plates, there is no need to trouble.

Now lay the positive and viewing screen film to film, and slowly rotate with the first fingers and the thumbs. A very minute movement will produce a checker pattern, or moirée, which gets bigger and bigger as one plate is turned upon the other. Then with a little further movement the pattern disappears altogether, leaving the whole plate of some one color. At this stage, a couple of bull-dog letter clips are slipped on opposite sides of plates to clamp them finally together. A *very* slight movement of one glass over the other, straight along one way or the other, will cause all the colors to appear in their true values.

Intensification or Reduction

Now we can judge if the result is satisfactory, or if it can be improved by further treatment of the diapositive. If the colors are poor and weak, the positive probably

requires intensification, for which purpose there is nothing better than the chromium intensifier, used according to the full instructions given at page 536 of The Photo-Miniature No. 143. On the other hand, too great density and depth of colors can be corrected by the use of the Farmer ferricyanide reducer.

Binding

The positive, with or without after-treatment, having been obtained in registration and held by the letter clips, it only remains to bind the two glasses together with the usual gummed strips used for lantern slides or, better, the somewhat stouter gummed edging sold for passe-partouts. A good tip here for avoiding slipping of the glasses under the clips, when applying the gummed strips, is that of Dr. D'Arcy Power, viz., to run a touch of fish-glue around the edges of the two plates and leave it to harden before putting on the paper binding.

Projection

The advantages of the Paget color slides over autochromes for projection are: first, their much greater transparency, and second, their comparative immunity from damage by the heat of the lantern. The latter quality is such that the slides can be treated pretty much as ordinary lantern slides, although it must be borne in mind that the viewing screen is liable to suffer from excessive exposure in a hot lantern-stage, and that therefore an open stage is preferable also for these transparencies. For viewing, the Paget transparencies suffer from the defect of altering their colors if looked at obliquely; they must be viewed "square on," which practically can be done only by means of a box fitted with sight-hole or lens for the eye. This drawback is not possessed by the Paget "combined" process, in which the emulsion is coated on the color-screen-plate after the manner of the autochrome; but these plates have not yet been placed upon the market.

Pictures in Monochrome

The Paget process, it will thus be seen, has certain positive advantages, the chief of which is the facility with which any number of duplicates can be made. Moreover, the plates are just like those in ordinary use, and call for

no special precautions in handling. A further point about the process is the ease with which an ordinary contact print, or enlargement upon a moderate scale, can be gotten from the negative made through the taking screen. The pattern of the screen is so fine that it is practically invisible in a matt print, and allows of 8x10 enlargements being produced from 3¼x4¼ or 4x5 negatives without structure showing to any unpleasant degree. Thus, with scarcely any addition to his equipment, the picture-maker obtains his lantern-slides in natural colors, and still can produce them in monochrome whenever he so desires.

The Hicro Process

In THE PHOTO-MINIATURE, NO. 128, several pages (383–392) were devoted to the processes by which paper prints or glass transparencies in natural colors are produced by superimposing one on the other, three differently colored impressions (pink, yellow, and blue-green) made from as many different negatives. The reader must turn to this earlier monograph for the plain story of the principle of such processes, scores of which have come up in the past, been heralded as "color-photography at last," and speedily been forgotten. But within the three years which have passed since NO. 128 appeared, a further great step has been made in bringing the triple superimposition process within the power of the unskilled. It is only necessary to give the name of its inventor, Mr. F. E. Ives, to provide the assurance that it is on theoretically right principles. Mr. Ives is recognized throughout the world as the leading investigator and authority in color-photography. But, in this new process, the "Hicro," he has done a good deal more then provide the theoretically right; he has reduced the practice to such a degree of simplicity and certainty that the making of prints and diapositives in natural colors calls for little more skill than ordinary photography. One might say, no more skill, but only somewhat more trouble.

What is the Hicro Process?

In the Hicro process, the first step is to make three negatives, recording respectively the redness, greenness, and blueness of the subject, but the difficulties and occa-

sions of failure in previous methods are swept away by making the three plates for each exposure a complete one-piece triple unit, which has simply to be put into a holder and exposed in a camera with barely any more preparation than one ordinary plate. This is done by having the three plates in a hinged metal carrier so devised that, at the time of exposure, the green-sensitive has its glass side facing the lens, the red-sensitive is film to film behind it, whilst the blue-sensitive plate lies horizontally in the camera, and receives the picture from a yellow transparent mirror, brought into position at 45° to the lens-axis after the holder has been fitted to the camera. The only other screen is one of magenta color, close behind the lens, the whole arrangement allowing of the exposure being one-quarter of that for the Autochrome.

Development is done in a tank for half an hour, and the plates fixed and dried as usual.

The making of the three separate impressions has been similarly reduced to a simple system. The trio of negatives is placed in a special printing frame. On the two recording blue and green is placed a strip of sensitive bichromate film: on that recording red, a sheet of special blue-print paper. All three are exposed together to daylight for a time indicated by a piece of solio paper in an actinometer. The film is developed in warm water, washed and dried. It is then fixed in hypo, cut in two, and one part dyed magenta and the other yellow. The blue-print paper is developed, fixed, and washed and dried very much in the manner of a gaslight print. The assembling of these three prints on one another is done by clipping first the magenta and then the yellow film in register on to the blue base, and securing one edge with a strip of binding tissue. All three, spread apart, are then dipped for a few seconds in amyl acetate, put between blotters and run through a roller press, after which the complete color photograph can be trimmed and mounted like an ordinary print. These details are sufficient to describe the manipulations of the Hicro process, which are very fully set forth in the booklet issued by the company formed to exploit the method commercially.

The Kodachrome Process

This method of producing color transparencies, worked out a little over a year ago by the Eastman Research Laboratory, differs from those we have already considered in the fact that it is a two-color process. The range of colors is obtained by recording the redness and greenness in the subject, and thus the process is admittedly defective in rendering blues, and colors such as violets and purples into which blue largely enters. But it is offered essentially for portraiture, and in that branch is distinguished by its very beautiful rendering of flesh tints and hair. The process consists in taking simultaneously, or in quick succession, two negatives, one through a red and the other through a green screen. One of this pair of negatives is laterally reversed in comparison with the other by the use of a prism, or by exposing one plate glass-side to the lens. The negatives are developed in the ordinary way. Then, either with or without fixing, washing, and drying, they are passed into a bleaching bath, by which the developed image, or rather the gelatine in contact with it, is converted into a state in which it absorbs dye very slowly, whereas the unaltered gelatine of the emulsion (that containing little or no silver deposit) absorbs the dye readily. The result is that each negative yields a dye positive, that taken through the red screen being dyed green, and that through the green screen red. These two dyed positives are bound up in register to form the color transparency. Worked in this way, the process yields one color portrait from each exposure, but the bleaching and dyeing can be applied just as well to reproduced negatives, and any number of duplicate transparencies can be thus produced by this method.

Kodachrome in Practice

The details of the process have been very fully worked out by the Eastman Company, by whom all the chemical preparations and appliances are supplied, including an installation of nitro bulbs for the exposure, the process requiring a very powerful light in the studio. Little can be said here in supplement to these instructions, which are particularly full in respect to the only part

of the process—the dyeing of the plates—which is something outside the track of regular work with panchromatic plates. The dye baths should be free from deposit—made and kept so by filtering—and should be maintained at full strength by addition, every little while, of fresh bath to that which has been in use. Plates should take up dye quickly (in about three minutes), and the take-up is finished as soon as full detail is brought out in the high-lights. The plates require a brief rinse with water, in order to judge of this point, and one can then be laid on the other and examined by artificial light, to judge of the color effect. If the whole result is too red or green, a little further dyeing of the other plate in its dye-bath will correct; but, generally speaking, the art in the process consists in dyeing quickly and passing the plates to the acetic stop-bath without letting plates hang about in the wet state. After the acetic bath, they are mopped surface-dry, and dried as quickly as possible with a fan. The green plate is then laid glass-side down on the film of the red plate in register, and the two clipped together. A thin binder is then put on, and, when this has dried, a cover-glass attached over the film of the green plate, and secured with stout gummed edging.

—George E. Brown.

BOOKS

Photography in Colors. By Dr. Lindsay Johnson. A non-technical explanation of color photography in principle and practice. Second (Revised) Edition, 1914. 244 pp., 5 plates in color. Cloth, $1.25. Tennant and Ward, New York.

The Photo-Miniature: No. 128. Color Photography. By George E. Brown. A descriptive account of the modern methods of obtaining photographs in color, giving principles and comparisons rather than practical instruction in manipulation. Price 25 cts. Now out of print, but obtainable from some dealers and accessible at the principal public libraries.

MAKING ENLARGEMENTS ON PLAIN PAPER FOR CRAYON FINISHING

Where portrait enlargements are required in quantities for crayon finishing, these can be made upon plain paper as readily as upon bromide paper, at very much less expense. Such enlargements were formerly known as "solar prints," and the method here described is still used by many large houses, turning out thousands of these enlargements year by year. The method calls for a negative soft and detailful, without harsh contrasts, such as are ordinarily made in the professional portrait studio.

The Paper The paper best suited for producing enlargements on plain paper may be obtained from most dealers in photographic supplies or artists' material under the name of Steinbach or Saxe paper. It is imported in rolls about 40 inches wide, but some photographic dealers retail it in sheets 18 x 23 inches at about 50 cents per dozen sheets.

Either of the above papers requires to be salted. As the paper, when salted, keeps in good condition for months, it is advisable to salt a number of sheets at one time. For the salting, we need a perfectly clean tray, and a few wooden clips with which to suspend the paper until dry after salted.

Salting Solution For the salting solution, we shall need a supply of serum of milk, and this should be prepared according to the directions given in the method for making enlargements upon fabrics. The salting solution is prepared as follows: Serum of milk, 42 fluid ozs.; potassium iodide, 1½ ozs.; potassium bromide, 160 grains. An alternative formula is as follows: Magnesium iodide, 1½ ozs.; serum of milk, 40 fluid ozs.; ammonium bromide, 218

grains; magnesium chloride, 80 grains. The salts in these solutions will dissolve quickly. When thorough solution has been obtained, the mixture should be carefully filtered through a tuft of absorbent cotton placed in a glass funnel and poured into a clean tray ready for use.

Salting the Paper To salt the paper, mark each sheet with a faint pencil mark to indicate the *back* of the sheet. Now take hold of the paper at the opposite diagonal corners with the finger and thumb of each hand so that it sags in the middle. Lower the sheet carefully down upon the surface of the salting solution so that it goes down upon the surface from the center of the sheet toward the corners held by the fingers. Now lift it up by one corner and see whether any air bubbles form upon the wet surface of the paper. If so, touch them with the finger and they will disappear. After examining the whole sheet from the four corners in this way, let the paper remain on the surface of the salting solution for three minutes, after which it should be lifted with a gentle sliding movement from the solution, drained, and suspended to dry. This salting of the paper may be carried out in daylight. When the sheets are dry, they should be kept flat in a portfolio or under pressure away from dust until needed for sensitizing. The sensitizing, of this paper, and all after operations, should be conducted in an orange-colored light.

Sensitizing Formula Distilled water, 32 fluid ozs.; nitrate of silver (re-crystallized) 3 ozs.; glacial acetic acid, 4 fluid ozs. The sensitizing solution should be applied to the salted surface of the paper, either by means of a tuft of absorbent cotton held in a glass tube to form a brush, or by the use of a cotton swab, as described in sensitizing fabrics. Where a vignette is desired, or only a portion of the paper is to be sensitized, the tuft of cotton in the tube will be found most convenient, and the sensitizer may be applied for about two minutes. If the whole sheet is to be used, then it will be better to float the paper upon the surface of the sensitizing solution, letting it remain thereon for three minutes, then withdrawing

the sheet from the surface of the solution over a glass rod placed at the end of the tray.

Exposing the Paper The picture to be enlarged is supposed to be already adjusted in the enlarging camera and focused upon the enlarging board or easel with the lens capped. Now fix the wet sensitized paper to the enlarging board or easel, remove the lens cap, and give the exposure. This will vary according to the quality of the negative, the degree of enlargement, and the distance of the easel from the lens. Five seconds may suffice in some instances, or it may run into as many minutes. A safe rule to go by is to examine the print upon the board during exposure. As soon as a faint image has made its appearance, the paper may be removed and developed at once. Either of the following developers may be used at will.

Developer Formulas Water, 38 fluid ozs.; gallic acid, 284 grains; acetate of lead, 192 grains; glacial acetic acid, 3 fluid ozs. *Alternative* (pyro) developer: Water, 64 fluid, ozs.; pyrogallic acid, 180 grains; glacial acetic acid, 5 fluid ozs.; saturated solution citric acid, 20 drops. *Alternative* (iron) developer: Distilled water, 30 fluid ozs.; protosulphate of iron, 1 oz.; glacial acetic acid, 2 fluid ozs.

Development and Fixing Lay the print, with the pencil-marked side down, in a clean tray, and pour the developer over the damp surface with one clean, even sweep of solution. The progress of the development of the image should now be carefully watched. As soon as the image is well out, pour off the developer, wash the print well in running water, then fix in a plain solution of: Water, 160 fluid ozs.; hyposulphite of soda, 32 ozs.

The time required for fixing a print of this kind will usually be fifteen or twenty minutes. In fact, it should remain in the hypo until the whites are quite clear, which may readily be seen by examining the print in white light. When every trace of yellow silver iodide has been eliminated, as judged by inspection, the print is fixed and may be washed for an hour in running water, after which it may be dried or pasted while wet upon cardboard or the usual canvas stretcher.

Toning if Desired Such prints may be further toned or strengthened in color by toning in a gold toning bath, such as the one recommended for toning prints upon silk. The addition to the fixing bath, as given above, of 8 grains of chloride of gold dissolved in 4 ounces of water is also recommended as giving prints rich in color.

Theater Posters For the production of very large solar prints, such as are used as the base for the life-size colored theatrical posters, now so much used in theater lobbies, the method already given is slightly varied.

Salting For the salting solution, the following is advised: Milk serum, 20 fluid ozs.; glacial acetic acid, 12 drops; iodide of potassium, 160 grains; bromide of potassium, 80 grains; the albumen of two eggs. The albumen should be equal to 2 fluid ounces in volume, and should be well beaten to a froth with a silver or plated-silver fork. It is first added to the serum, after which the salts are added, with continual shaking. After solution is complete, the mixture should be filtered and lightly applied to the paper with a cotton swab. This operation should occupy about two minutes for a sheet, say, 40 x 40. The salted paper is then suspended by clips to dry, away from dust.

Sensitizing The sensitizing is also done by swabbing the sheet with the following solution: Distilled water, 5 fluid ozs.; nitrate of silver (re-crystallized), 200 grains; glacial acetic acid, ½ fluid oz. After exposure as usual, the print may be developed in any of the developers already given, or the following may be used: Water, 20 fluid ozs.; pyrogallic acid, 2 drams; glacial acetic acid, 2 fluid ozs.; potassium bromide, 8 grains. After development, the prints should be well rinsed and fixed in a bath made by dissolving 1 pound hyposulphite of soda in 40 ounces of water. Fifteen minutes' immersion will suffice.

Toning or Intensifying The following toning solution is recommended for the toning or intensifying of solar prints. Prepare *Solution A*: Distilled water, 20 fluid ozs.; acetate of soda, ½oz.;

ammonium sulphocyanide, ½oz.; hyposulphite of soda, 4 ozs. *Solution B*: Chloride of gold, 10 grains; water, 2 fluid ozs. Solution A is most conveniently made with hot water. After the solution of A is complete and quite cold, add the gold solution B. This bath may be used repeatedly by adding occasionally an ounce or two of gold solution, prepared as directed for Solution B, to offset the sluggish action of the bath.

Notes and Comment

Mr. H. C. Lord, of the Emerson-McMillin Observatory attached to the Ohio State University, at Columbus, Ohio, has very kindly sent me a few extra copies of his paper on "The Making of a Photographic Objective," recently noted in these pages. If any reader desires a copy of this interesting description of how photographic lenses are made, I should be glad to send him a copy on request. This note will also serve as acknowledgement of the receipt of a further paper by Mr. Lord, on "The Illumination of the Field of a Photographic Objective," reprinted from the monthly notices of the Royal Astronomical Society. This paper deals with a detail of great importance in practical photography and, for those who do not mind mathematics, the explanation given by Mr. Lord will prove of considerable interest.

The question of exposure is, of course, "the eternal question" in photography. I note the appearance of at least four new exposure charts, meters, discs, etc., in the current magazines. Which serves to remind me that the handiest and most satisfying guide to the whole problem is to be found in THE PHOTO-MINIATURE No. 105, "Correct Exposure and How to Calculate It," with illustrations of the different classes of subjects.

Dr. C. E. Kenneth Mees, of the Eastman Kodak Company, has returned from a Bermuda holiday and is again busy in his research laboratory. There are rumors of changes which will greatly improve the Kodachrome process, making it simpler and more effective. I hear, also, of other novelties to come out of the Kodak City before the summer is over, which will be of unusual interest.

The new edition, 85th thousand, of the American Photography Exposure Tables, is completely revised, containing accurate tables for determining photographic exposures under all conditions and in all latitudes. It lists all plates and films now on the American market with their relative speeds, and offers much useful information on the subject of exposure outdoors and indoors by day or night, for still or moving objects, and for copying, reducing and enlarging. Price 25 cents. American Photographic Publishing Co., Boston.

From far-away Morobe, Papua, New Guinea, comes a letter of warm appreciation of The Photo-Miniature which an amateur of twenty years' standing had just discovered in that odd corner of the world. The writer was Sergeant of Police, Albert E. Smith, and accompanying his letter were three hand-camera pictures of groups of natives of New Britain and a village road. Mr. Smith tells of the many difficulties encountered in photography among the islands of the South Pacific because of the heat and dampness out there. He tells me that he finds the Nepera gaslight paper and bromide papers most reliable for that part of the world, and that, as a rule, time exposures with a tripod give better pictures than instantaneous exposures with the lens at its largest aperture. Apparently the use of Hypono is indispensable out there as eliminating 90 per cent of the time usually occupied in washing plates and films and thereby saving the negative film from deterioration.

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Failures—and Why: Printing and Enlarging

A little while ago I carried out an idea that I had long had in my mind, namely, to publish in one number of this magazine a complete handbook to the many and various mishaps which can befall one in the making of negatives; the things for which there is no remedy, yet which, when once their causes are understood, "never can happen again." THE PHOTO-MINIATURE, No. 145, is the issue in which this idea is embodied. It differs essentially from most other numbers, but I am glad to find that the innovation is one which has found favor as the kind of practical help the average worker needs. The object of these monographs is to make good photography easier and more certain; to give practical information without waste of words; in which good work No. 145 of this series most emphatically plays as useful a part as any of its fellows. So I thought at the time, and my judgment has had endorsement from many quarters.

THE PHOTO-MINIATURE, No. 145, however, dealt only with failures in negative-making, and therefore I set before myself the work of supplementing it by a companion volume which would render the same service to the less-skilled beginner in the even wider field covered by the production of the finished print or enlargement. Here I had to discriminate, for some printing processes have so far gone out of popular favor

that it would be waste of time to say much about them. Nevertheless it is fair to claim that the present monograph locates the difficulties commonly met with by the beginner in working the processes in general use today for the making of prints; and further, by the direct method of saying that this or that is the cause of such and such a failure, it does a good deal to make the beginner a master of his work.

The reading of long chapters on the principles of photographic processes is a dry business. It becomes interesting in proportion only as one is able to connect a fact directly with the avoidance of some conspicuous flaw in one's results. In brief, even a failure can be made interesting if we see in it a way to success. So with great goodwill I have sought in these pages to offer the reader such knowledge and experience of failures in printing and enlarging, chopped fine and sorted so that the particular bit that is of value can be got at and usefully applied in practice.

Negative and Printing Process

Before I come to my subject proper, it is necessary to say more than a little upon a point which, in defiance of Euclid's definition, covers the whole ground we propose to traverse in these pages. That is the selection of the printing process which will give the best results from different kinds of negatives. The reader is at liberty to take what I have to say in either of two ways. He can accept it as an indication of the choice to be made among printing processes when seeking to secure the best possible prints from negatives which may be defective in one or another of several different respects. On the other hand, he may receive it as a guide in the making of negatives which shall do the maximum justice to the quality of this or that printing medium; or, equally, as a guide in improving negatives to the same end. In my own mind, there is no doubt that it is in one or other of the two latter directions that these preliminaries are most likely to be of benefit to the beginner.

It is a more practical programme to make negatives for a given printing process than it is to search around among all and sundry printing papers, to find one

which just suits a particular kind of negative A or another which fits another kind of negative B. A and B may be good enough negatives for their respective printing papers if one can find them, but it is an *if* of some size, and broadly it is not the way in which a photographer who has to earn his livelihood by his craft goes about things. There remains, too, the fact that a negative is good or bad only as the print shows it to be so (Hamlet's philosophic dictum in a photographic application); hence, without seeking to coerce the gentle reader as to what he should do, it may be profitable to know just where failure in print-making may creep in, not from any fault in the working of a process, but simply because one is handicapped from the start by using a negative unsuitable for the printing paper in use at the moment.

The Ideal Negative

Which is not to say that there is no such thing as an ideal negative, viz., one which yields perfect results by any of the printing processes now available. Scientific authorities notwithstanding, I maintain that there is. We all make such negatives at times, and we usually know them when we see them by their clean shadows (with just a veil of deposit over them), not over-dense high-lights, "brilliant" appearance, and freedom from any general stain. It is common experience that a negative such as this, without any recourse to faking methods, will do justice to itself in platinum or carbon, bromide or D. O. P. (gaslight), print-out or self-toning paper, and will not fail to yield a first-rate enlargement. Unfortunately we make all too few negatives which are all things to all processes, and the recent introduction of printing papers suitable for every kind of negative has removed the incentive to realize these qualities of perfection in the development of our camera exposures. The fact is constantly a complaint of those who make prints or enlargements from photographers' negatives.

A Basis for Comparison

Leaving then our ideally perfect negative, we must seek to form a mental picture by which to guide ourselves in judging the suitability of a negative for this or that

printing process. Here the negative which under usual conditions yields a good print on a development paper such as ordinary Velox serves better than any other. By "usual conditions" I mean straightforward development with metol-hydroquinone, following a fairly correct exposure. The main thing is the contrast in the negative, i. e., the range of gradation. In a negative which prints well on Velox or any other similar gaslight paper it is small. The high-light densities, far from approaching opacity, are more correctly described as a deep gray if the shadows are nearly clear glass. In other negatives of the same degree of contrast and yielding prints similar to that just mentioned, all the tones are denser, as the result of longer exposure and full development. Nevertheless their general appearance stamps them as possessing only moderate contrast: those accustomed to make negatives before the days of gaslight papers would call them flat. At any rate, pick out one or two negatives of this kind from your stock and endeavor to carry their degree of contrast in your mind's eye, thinking of it as that "for average gaslight printing" or other method for comparison.

Fairly Contrasty Negatives

In comparison with a negative such as that just described, it is not a difficult matter to size up one several points more contrasty. The greater density of the high-lights in relation to that of the shadows marks this superior degree of contrast, or "pluck." Such a negative will work to best advantage with either platinum or self-toning paper, either of which calls for contrast distinctly above the average. Of late years, there has been a considerable yielding, if I may put it, on the part of platinum paper as to the kind of negative which is called for. It is no longer the fact that for rich vigorous platinum prints one wants a quite strong negative: the latter requires to be of only little more "pluck" than one for development paper, provided it is clean and free from general fog. At the same time, it does not require to have absolutely clear glass in the shadows, since that is a feature which is a case of clogged heavy shadows in the print, exhibiting what is termed "solarization," an effect which may be marked

by distinct differences of color between these and other parts of the picture. In the case of self-toning papers, very much the same applies; except that the glass-clearness in the shadows of the negatives is liable to result in a choked-up, almost metallic appearance in corresponding parts of the prints.

Bromide paper is eminently suited to negatives of this kind, since it is one which lends itself in a high degree to adjustment to particular negatives by use of a contrast-giving developer, such as hydroquinone, if the vigor is below par; or by the addition of water to the metol or amidol developer, if the prints are too "contrasty" or black-and-white.

Very Contrasty Negatives

When we come to negatives possessing still greater contrast, we have to turn to two other printing processes as those which yield the best from them without recourse to special methods. Carbon is undoubtedly the process which will stand most contrast in the negative while yielding first-rate prints. In justice to it, it ought to be said that it is capable of dealing with comparatively flat negatives by the use of a much weaker sensitizing bath for the tissue, but at the sacrifice of much speed of printing—the tissue is several times slower. Next to carbon comes collodio-chloride paper which is not in favor with amateur workers, though one yielding, from a suitably vigorous negative, prints of superlative richness and quality, superior, perhaps, in their "handsome" appearance to those by any other process. Like carbon, collodio-chloride paper yields its best to a negative of considerably more than average vigor.

Hopeless Under-Exposures

The negative which has received much too little exposure and has, moreover, been fully developed or, as often happens, forced in development, is the hardest of all to print satisfactorily, whatever the process. Its hardy, heavy deposits in the high-lights and absence of detail in the shadows make it an almost hopeless problem. Probably bromide paper, with suitable exposure and judicious dilution of the developer, will give a better account of it than any other printing medium. But there is a process for faulty negatives of

this kind which is so effective that I may be pardoned for mentioning it here, although I am trespassing on the fields of defective negatives very thoroughly covered in The Photo-Miniature No. 143. It is to bleach the well-washed negative in a solution of mercury bichloride, as used for intensifying. When whitened through to the glass side, wash for a minute. The negative, if now held over a dark surface, such as black velvet, has the appearance of a very soft positive. The method is to leave it in this positive form and to make a second negative from it by copying in the camera; but before doing that it is well to give it just a touch of extra pluck or brilliance by dipping it for a few seconds in a very weak solution of soda sulphite—a crystal about the size of a pea in five or ten ounces of water. This action must be only very slight—more than a few seconds will spoil the whole of the positive,—and the plate is then dried, backed up with black velvet, and copied, glass side facing the lens. The "copy negative" will always be a great improvement in gradation upon the original.

Flat Negatives

I need say little about negatives which, on the other hand, suffer from too little contrast, since ample means for dealing with them are available in the harder-working development or gaslight papers. And it is unnecessary to dwell at length on the negative best suited to these papers, for the reason that their variety provides for every grade of negative, from hard to flat. The popularity of the gaslight system of exposure and development has led makers to originate a grade for every negative, and very thoroughly have they carried out their programme.

Stained Negatives

I ought to add a word on the printing of negatives which, through faulty developer or development, have a more or less heavy general stain. In such cases, it will generally be found that a development paper is necessary,—at any rate, if a number of prints are required. Stain prolongs the exposure of print-out papers to such a length that the work of daylight prints becomes tedious, and one is pretty certain to get results either under-

printed or else overdone; the latter, through disgust at the slowness of the business and the consequent resolve to leave the frame to itself for an hour or two and chance things going too far. But the most stained negative yields to bromide paper after an exposure of some seconds, or a minute or so at the most. Development paper is less fitted for such purpose, for exposure with it also may be inconveniently long, unless made to daylight or a very strong artificial light.

DEVELOPMENT PAPERS

Now let me come to the "failures—and why" of printing on the popular development or gaslight papers. I suppose one could say, without fear of exaggeration, that 70 per cent of the photographs turned out today in America are prints on gaslight paper. And I can't help adding that, inasmuch as development-paper printing is by no means a simple process, the popularity of this sort of paper is an unanswerable argument in favor of the power of the photographic press as a medium of publicity.

As almost everything here said as applying to development-paper failures applies equally to failures in bromide-paper printing, I will not deal separately with this latter paper.

In the first place, we must realize the common-sense fact that it is hardly ever worth while to try to patch up a defective print by after processes, such as intensification and the like. The result is rarely satisfactory in appearance, and the permanence of the print is generally open to grave suspicion. It is better to learn how to recognize the "why" of a failure at a glance and, with that recognition of the cause of failure, to set about to make a good print *ab initio*, as the learned say, to wit—from the beginning.

Fog or Veil on the Print

By "fog" on a print I mean that strong, gray haze or surface deposit or veil which comes over the whole of the print, even to the narrow edge strips protected by the rebate of the printing frame or by any mask which may be used between negative and paper.

Stale Paper

This fog may arise from the paper being stale with age, in which case the fog is seen to spread from the edges inward.

If it is thought worth while, stale paper can be restored by giving it a one-minute dip in a bath of: Potass permanganate, 10 grains; sulphuric acid, 1 dram; water, 100 ounces, and then transferring it directly to a solution of 200 grains soda sulphite in 10 ounces of water, where it remains also for one minute. It is then rinsed and dried (in the dark), or can be exposed wet on the enlarging easel. This process reduces the speed of the paper to about half. To my mind, this restoring formula is of value only if one has a few large sheets of bromide or gaslight paper which can be used up for enlargements.

Unnecessary Light Exposure

Exposure to light before or after printing is, of course, a cause of similar fog. It often arises from leaving papers lying about; rather than taking the trouble to slip unused sheets back into the envelopes. Therefore I say: Make or buy a light-tight box for holding papers. The best pattern is one about three or four inches deep, and with a hinged lid, fitted with a spring, so that the lid closes of itself when let go after a sheet of paper is withdrawn from the box.

Light during Development

Unsafe light during development likewise fogs. If you develop by weak daylight or in the shadow cast by some artificial light, remember that, with most gaslight papers, fogging is only a matter of length of exposure to the developing light. I prefer to handle gaslight papers in a bright yellow light from a darkroom lamp. If you have not the facility of a darkroom, you can usually wrap one electric bulb in yellow fabric, to serve as the lamp, and can use another on the other side of the room for exposing.

Chemical Contamination

Contamination of the developer with hypo is a ready cause of fog. There is no need for the fingers once to touch hypo in working off a batch of a few dozen prints. First, have a tray of ample size for the fixer, say 10 x 12

or 12 x 15 inches. Next, keep a print-paddle at hand and, as each print is developed, let it fall into the fixer and push it well under the surface with the paddle. With an occasional move around (with the paddle) the batch of prints will come to no harm in the fixer until all are developed, when you should turn each over singly in the bath and leave for another five minutes before putting to wash. In this way you will avoid spoiling the developer with hypo.

Lack of Bromide

Insufficient bromide in the developer will cause fog, but a very little is needed to put matters right—only a drop or two of 10 per cent solution to 4 ounces developer. Too much will spoil the color of the prints. Note that the extra slow gaslight papers, such as Artura and Professional Cyko, are different in this respect, withstanding heavy dosing of the developer with bromide without the color suffering.

Too warm a developing solution will cause fog. If the temperature cannot be brought down, a slight further addition of bromide will remedy matters.

Forced Development

Forcing the development too long, in the effort to get something decent out of an under-exposed print, is again a cause of fog, as is also wrongly compounded developer, e.g., with too much alkali. With gaslight papers, it is of the first importance to follow the maker's formula exactly, or to use some reliable developing tablet.

Beware, too, of the "substitute" developers now coming into the market. Many of them are utterly unreliable and will leave destruction, disappointment in the prints and loss in their wake.

Dampness

When fogged or veiled prints are obtained in circumstances which rule out the foregoing causes of failure, a further possibility is dampness of the printing paper. It is a cause of poor results, which in damp climates is not sufficiently recognized. I have constantly met with cases when the persistent veil obtained on every sheet of a batch disappeared on leaving the paper in a warm dry place overnight, or on putting it in a calcium-chloride box.

In the above cases, the veil or fog will extend to all parts of the print, whether exposed or not. Fog which is accompanied by cleanness of the parts of the paper shielded from light is due, as a rule, to over-exposure.

Harshness of Contrast

This is shown by the "black-and-white" character of the prints: dense black shadows, bare whites, and absence of delicate tones; also by the limited number of separate tones.

The cause is choice of a paper too hard or contrasty for the negative. You need a soft or portrait grade or one of the extra-slow special papers (Artura or Professional Cyko) which allow great latitude in their treatment, e.g., enable you to deal with stronger harsh negatives by giving full or over-exposure and developing for a short time or with a weaker solution. But, with the customary or normal grades of gaslight papers, these methods are of little avail.

Flat Prints

Here we have the opposite defect, gray instead of black shadows, veiled instead of almost clear whites—a general muddy appearance. There is detail everywhere, but no "pluck" or brilliance.

The paper in this case is too flat or soft for the negative. Failing intensification of the negative, a harder or more "vigorous" grade will yield the desired result in the print.

Over-exposure

Over-exposure, or too little bromide in the developer, is likewise a cause of flat prints. Too great an excess of the one or deficiency of the other will result in positive fog over the whole picture. In fact, it must be borne in mind that flatness is equally the result of general fog arising from one or other of the causes already mentioned under the first heading of this section.

Developing Formulæ

Too weak a developer, or an unsuitable formula, will also have the same result. The M. Q. developer is used for gaslight papers largely for the brilliance of the prints obtained with it: with almost any other there will be complaint of flatness, unless it be a good amidol formula.

Greenish Color This defect in gaslight prints is due to slight under-exposure coupled with long-continued development in the effort to get out detail in the high lights. A print should develop freely and easily, otherwise the general tone or color is bound to suffer.

Brownish Color On the other hand, rusty brown tones result from over-exposure and too much bromide in the developer (with the exception already stated).

The beginner may make the mistake of over-dosing the developer with bromide, in order to get clean bright prints, and then finds that, no matter what exposure he gives, the color tends to be rusty, instead of a good neutral or bluish black. Often the defect is not discovered until a batch of prints has been developed, fixed and brought out into full daylight, the brownish shade being masked in a yellowish illumination.

The preventive is to add bromide with great caution, testing its effect by exposing a scrap of paper under a negative before actual use.

Over-use of the Developer Remember this, too. As the developer is used for a number of prints, its power to yield good color falls off before it begins to fail to yield good vigor in the prints.

The preventive here is not to stint developer, and to keep track of its retention of full quality by taking a look at a print every now and then in daylight, after a fair number of prints have passed through the one lot of developer solution.

Stale Developer Stale developing solution, particularly when amidol is used, bad sulphite, and inferior quality in other chemicals are likewise the cause of bad color in prints, although it is not possible to state their effect in exact terms.

A Remedy for "Rust" A development print of bad color, whether greenish or brownish, will always be greatly improved by bleaching it with potass bichromate and re-developing, viz., the usual chromium—intensification process. The following bleacher, however, gives very little-intensification: Potass bichromate, 100 grains: hydrochloric acid,

3 drams: water 10 ounces. The print, well washed from hypo, bleaches to pale buff in about two minutes, is washed for about a quarter of an hour (until yellow stain is gone from the whites), and is then re-developed with amidol.

In many cases this process not only removes the unpleasing shade but yields a black which is better than that got by direct development.

Brownish Patches

The most common cause of these brownish or yellowish red patches is improper fixation.

Sometimes the marks have a straight edge, showing where the print has been kept away from the fixing solution by another pressing on it. In other cases prints are allowed to float on the surface of the hypo bath, and parts thus escape full fixation.

In fixing, the first thing to do is to immerse the print fully under the surface of the hypo solution with the print paddle or a length of hard wood, such as a 12-inch rule. If this is done, it will keep underneath. Then, when all prints are in, you can turn each over separately (best into a second fresh bath), and so insure full action of the fixing solution on each.

I would add that these brown stains may make their appearance only after a time, although the sulphide-toning process shows up at once.

Yellowish Stain

When this appears over the whole print, it usually arises from stale or over-used developer.

Papers vary greatly in liability to stain, some being very prone to it, others almost completely free.

Predisposing causes are long-continued development (never of much use with gaslight papers) and the practice of taking prints constantly out of the developer. Papers which develop slowly (that is in two or three minutes) should be kept under the solution the whole time.

Yellowish stain, once it has attacked a print, is not at all easy to remove completely. For myself, I throw such prints away rather than spend an hour over them on the chance of remedying them; with an equal chance of spoiling them for good. Almost the best advice I

can give is to put the prints through the chromium-intensification process, as directed in a preceding paragraph, or tone them to sepia by the sulphide process, when any slight yellowish stain will be less noticeable than in the black print.

Stress Marks Until a few years ago, irregular black lines and scummy marks were the bane of glossy and semi-glossy development papers. Improved methods of manufacture have now made them far less frequent; almost non-existent, in the case of several brands.

Cause The cause of these markings is abrasion of the emulsion surface before or during development. Thus they are occasioned by rubbing the paper against the negative or against other sheets when cutting up; by rubbing it against the bottom of the developing dish; or even by using developing solution containing much sediment. Crowding too many prints into the developer at a time favors their occurrence.

Remedy The recital of these causes is sufficient to indicate the means for avoiding the markings. A little 10 per cent solution of potass cyanide (intense poison) added to the developer is sometimes found an effective preventive dose, ½ to 1 dram cyanide to 10 ounces of developing solution.

Removal These "stress" or "abrasion" marks can be removed, though it is a tedious business if any great number of prints has to be dealt with.

Lay the wet print on glass and rub the surface firmly with soft wash (chamois) leather, moistened with alcohol or with a solution made of borax, ½ ounce; alcohol, 5 ounces; water 20 ounces.

Blisters Development papers are again much less prone to blisters than formerly. Many emulsion papers are almost impervious to the effect of warm solutions, and thus have little tendency to develop blisters as the result of difference of temperature between baths.

The most common cause is the use of too strong a fixing-bath, or rather the transference of prints from

such a bath into plain water. What happens then is that water diffuses into the pores of the emulsion more quickly than the strong hypo solution can diffuse out. Hence pressure at weak spots in the gelatine film, and the distention of the latter into bubbles or blisters.

This is likely to occur only when the hypo bath is made up haphazard: a bath of 4 ounces of hypo in 20 ounces of water will scarcely ever give rise to blisters. If it does, the thing to do is add an equal bulk of water to it (without taking out the prints); let prints soak in this weakened solution for a few minutes, and then transfer them to the wash water.

Frilling

With paper having a tendency to frill, the use of washing tanks in which fine jets of water strike the prints is liable to start the defect. Prints are freed from hypo quite effectively by passing each singly from one dish of clean water to another. Six or seven changes in this way, with a five-minute soak after each, is as effective as any mechanical washer ever made.

Soaking in alcohol followed by laying between blotters will remedy many cases of blisters; or the print in the alcohol-bath may be squeegeed down on well-cleaned ground-glass, and stripped off (matt) when dry.

Curling of Prints and Post-Cards

Development papers having a gelatine coating on one side only, prints naturally curl on drying; the contraction of the gelatine film draws the picture side of the print into a bowed form.

Prints on thin papers are easily straightened out by drawing under a ruler.

With papers of thicker substance, it is best to keep the prints flat during drying. The readiest plan is to lay prints *face* down after washing, on gauze or butter muslin, to become about three parts dry. When surface-dry, but with still enough moisture in the body of the paper to keep them limp, they are put one on another under light pressure (a few pounds), and will then be almost perfectly flat when dry. For postal cards, a simple plan is to nail down a couple of wooden slats five inches apart. The cards are set, film-side upward, between these parallel strips, the five-and-a-half inch

card being bowed outward, and thus receiving a curve which goes to oppose that caused by the contraction of the gelatine film.

A similar principle is embodied in the excellent drying-machines lately introduced, I think, by the Eastman Kodak Company.

Failures in Sepia Toning

I ought not to leave development papers without saying a word on the failures directly experienced in toning prints. I shall not attempt to deal with the many toning processes, but only with the best of the lot, viz., that in which prints are first bleached and then darkened to a sepia color in a bath of soda-sulphide. In this so-called and widely practised "sulphide-toning," there are few opportunities for failure. My brief list (below) includes all those which are commonly met with.

It should, however, be said that prints must be fully fixed. That is more important than thorough washing. Incomplete washing has chiefly the result of exhausting the bleaching bath more quickly, but imperfect fixing leaves silver compounds in the film, which are almost certain to cause dark stains in the sulphide bath.

The chief failure is weakness or paleness of the toned prints, coupled with unpleasing color.

Color, here, as everywhere else, is largely a matter of taste. In a somewhat extensive experience of complaints of sulphide-toning, I have often noticed that one worker will dislike a tone which another worker is anxious to get.

Most people, I fancy, don't want a true sepia,—it is too yellow for the general taste,—but prefer a tone better described as a warm brown.

Want of vigor in the prints is not the subject of misunderstanding; nobody wants the flat, washy results which are obtained at times.

The most frequent cause of failures, as regards both depth and color, is exhausted sulphide bath. Never put your sulphide bath aside for use another day. Best to dissolve the sulphide at the time of use, or, at any rate, to make up the working bath from a 20 per cent stock solution and use ample sulphide bath for a batch of prints.

Let me make it clear that a sulphide bath which has spoiled by keeping or over-use is not simply slower or weaker in action than a fresh bath. It has a most injurious effect on prints, for it renders them incapable of reaching full vigor in a fresh bath.

The reason for this probably is that hypo is formed in stale sulphide solutions and, if present in sufficient proportion, *dissolves* part of the bleached image. No subsequent sulphide bath can make good this evil. If, as rarely happens, the bleached print is not darkened at all by the sulphide bath, the exhausted condition of the latter is, I think, also the cause and for the reason just stated.

But, apart from the sulphide, the kind of print has a great deal to do with good vigorous-toned results. The original black print should be fully developed. If a paper requires two, three, or four minutes for development, half a minute's development will almost always lead to inferior-toned prints, even though the quickly developed black prints may look as well.

As regards unsatisfactory color, I would say this: If the prints are strong and brilliant, the color will almost always be a pleasing one. Bad color generally goes hand in hand with the washy results due to the causes I have just considered.

SELF-TONING PAPERS

A No-Failure Paper

There is no printing process in which the opportunity for mistake has been reduced so nearly to the vanishing point as in the use of self-toning papers. Hence my recital of the mishaps which can occur is the shortest in the present list. The difficulty of making prints of tone which is both good and the same throughout a batch is almost entirely removed by the makers of the paper. The call for care and judgment which remains relates to printing to the proper depth, and to handling prints in a way which will not lead to lack of permanence. On these and one or two other matters something useful can be said for the helping of those who have had no experience with these papers.

Curling Prints Self-toning papers with collodion emulsion—superior in its results to gelatine emulsion—have the awkward property of curling in the baths, sometimes to an extent which is a nuisance.

This can be almost completely overcome by putting prints, for the first wash, into a very small depth of water. Put them in one on top of the other, so that they press on each other, using only enough water to cover the lot. In this way you keep prints fairly flat from the start, with the result that they will not show the usual pronounced tendency to curl in the tone-fixing bath and final wash water.

Light Prints These result from under-printing. Self-toning paper needs to be printed considerably darker than the finished picture is required to be. The high-lights should be tinted over, and the deepest shadows just beginning to show a bronzed appearance.

But the degree to which the print must have this overdone appearance depends in a very large measure on the kind of negative. If it is one of thin, weak character, one which prints to this depth in five or ten minutes, then the degree of over-printing must be correspondingly greater. In other words, the quicker the printing, whether such be due to the negative or to the strength of the light, but chiefly to the former, the greater the tendency to get pictures which are too pale. Keep this fact in mind, and you will soon realize to what an extent prints go lighter in the hypo fixing bath from this cause.

Dark Prints These are due to over-printing. Here exactly the opposite conditions hold good. The longer a print takes to reach the slightly over-printed stage, the less amount of over-printing is required. The usual mistake in such circumstances is to get prints which are too dark. I lay stress on these two points because I think they are the chief source of a beginner's difficulty in getting pictures each of just the right depth from a lot of different negatives. As regards the kind of negative which gives the best result on self-toning paper, see

what has already been said in the first chapter of this monograph.

Prints which are too dark are best left to soak in a hypo bath of strength double that recommended by the makers, and will then slowly get somewhat lighter, though not very much so.

Unpleasant Red Tones

With some papers, the cause of reddish, instead of brown and sepia, prints by tone-fixing in a plain hypo bath is too much washing in plain water at the start.

The reason of this no doubt is that prints tone better if the hypo bath is slightly acid, due to acid or acid salts carried into it from the emulsion in the paper. On this account, you find some makers advise putting prints straight into the hypo without any washing at all. That may be all right as regards tone, but it is not the best thing—in fact it is a bad thing—as regards permanency of the results. I usually add a pinch of sodium-carbonate to my plain hypo bath.

It is just as bad for a self-toning print to be fixed under these conditions as it is for one on ordinary print-out-paper; and it has long been recognized that a neutral, or better an alkaline, fixing bath is necessary for P. O. P., if permanence is a chief consideration.

Therefore my advice is to choose a brand of paper which will yield a good sepia or brown tone, even when prints are first washed in three or four changes of water, or (which amounts to the same thing) if a little carbonate or bicarbonate of soda be added to the fixing bath in order to take up and neutralize its acidity.

This is a point the neglect of which is, I believe, the chief reason why complaints are sometimes made of self-toning prints fading within a short time.

PLATINUM PRINTING

Different Papers

The easiest process of platinum printing is that which gives black prints with cold development, but most of the hints here given apply equally to the use of sepia papers with hot development (sepia platinotype) or cold development (Angelo).

Muddy Prints A generally flat, dark appearance of the print with no clear high-lights most commonly arises from dampness of the paper. The paper speedily spoils by absorption of moisture, and therefore requires to be kept in a calcium-chloride tube or case up to the time of loading into the frame. The paper may become damp during printing by contact with a damp negative, or being insufficiently protected from a damp atmosphere.

Always make it a rule to back up the paper in the frame with a waterproof sheet of rubber, waterproof cloth, or celluloid; also, if printing has to be done out-of-doors in wet weather, it is well to use a frame a size larger, fitted with plain glass. This largely safeguards the paper from damp getting in around the rebate.

It is just as necessary to keep the paper dry after exposure by putting it in a calcium tube, unless prints are to be developed within an hour or so, or sooner than that in moist climates.

A Dry-Storage Box Here I would lay stress on a matter which very often is the real cause of these "damp" troubles. It is that too little calcium-chloride is used in the drying tube, or that it is kept in use after it has lost its power of absorbing moisture. A tube which is constantly being opened needs more calcium compound in it than one which is sent out sealed by the makers in the ordinary supply of the paper. For holding not only platinum but also other sensitive papers, I prefer to use a good-sized well-made box of wood, but better of metal, fitted with a close-fitting lid. I fit a shelf or skeleton false bottom in it, making a platform a few inches high. In the space below, put a few pounds of calcium-chloride in shallow dishes. It is out of the way, and loose particles cannot get at the packets of papers laid on the shelf above. Calcium-chloride is very cheap stuff, so there is no need to stint it, and when it is seen to be getting damp, it can easily be made good again by heating in an old saucepan. A dry-storage box of this big home-made description is a fine thing also for carbon tissue, as well as for print-out and development papers. It keeps them in the best condition, and is a preventive of

many flat prints, the unsuspected cause of which is dampness in the paper.

Stale Paper For paper which has become spoiled by damp there is really no satisfactory means of dealing. If it is only a matter of age (the paper having been kept dry), then the flatness of the print can be obviated by adding bichromate of potash to the developer. A convenient strength of stock solution is 30 grains per ounce of developer used. A quantity ranging from a drop or two up to 1 dram, added to 40 ounces of developer according to the degree of staleness, will secure pluck in the prints, though the color is scarcely ever the fine pure black obtained with paper which has not "gone off." Bichromate is effective with cold or slightly warm developer; its action is almost nil in solutions above 100° F.

Light-Fog Also careless handling may lead to muddy flat prints. Although platinum is a daylight-printing process, its sensitiveness is several times that of print-out-paper, and more care is required in shielding it from general exposure, particularly so with the more rapid sepia platinotype. Use a weak indoor light for loading frames, as also for examining the progress of printing.

Pale Prints These are due to under-printing. With paper for cold-bath development, a higher temperature of the solution (100° F.) will often bring up the image to sufficient depth, but the color then usually is of a brownish hue. Another remedy is to develop in the ordinary way and then to tone by one or other of the uranium methods of the late James H. McCorkle, according to the full directions contained in THE PHOTO-MINIATURE, No. 115. The toner increases the depth, and as long as there is detail throughout the image the results are very satisfactory. Moreover, general experience has shown that the uranium-toned platinum prints, unlike bromides treated by a similar process, are fully permanent.

Dark Prints If the paper, exposed as it should be (viz., until detail is visible everywhere except in the highest lights), gives prints which are too dark, the cause is probably damp-

ness. With damp paper the image is not so plainly visible, and thus it is fatally easy to make the mistake of over-printing.

Remedy for Overprinting There is no satisfactory method of reducing the depth of a finished platinum print. If one print gives you a hint that others have been over-timed, the best thing is to restrain the usual developer by adding to it, first, about half its bulk of water, and then glycerine to the amount of half or the whole of its bulk, e. g., usual working developer, 4 ounces; water, 2 ounces; glycerine, 2 to 4 ounces. This will develop more slowly,—in about 5 minutes,—but will save the prints from being too dark and flat; although you must not expect the color or quality to be equal to that of prints exposed and developed in the regular way.

Chalky Prints Prints of the "soot-and-whitewash" order are due to too hard a negative. Failing improvement of the latter, the best plan is to use a cold-bath paper, but to warm the developer to 70° or 75° F., adding a very little hydrochloric acid. A drop or two of the acid clearing bath in the developer is enough to make the prints softer in general effect.

Red Color in Black Prints In addition to errors in exposure, black platinum paper is very sensitive to mercury in any form. Its effect is to make the color of the print warmer. With a mercury-intensified negative, it will often be impossible to get a print of proper black color; and sepia paper, if stored with "black," will cause stains in prints made on the latter. For the same reason, black paper should not be developed in a dish which has been used for sepia, otherwise the purity of the black tone will be affected.

Granular Prints A grainy appearance over the whole print is the result of incomplete development, that is for too short a time. It arises from the developer failing to penetrate thoroughly into the depressions in the paper. Although a platinum print comes up almost instantaneously in the developer, the action of the latter takes a little time (something less than a minute) to be complete throughout the

substance of the paper. If the developer is unduly cold, it takes longer than this. Hence cold developer is often put down as the cause of granularity, although it is so only indirectly. There is no remedy for the unpleasant granular appearance of a print. Weak or exhausted developer tends to the same effects, owing to its longer time in penetrating the sensitive paper.

Yellowish Stain A yellow-brownish stain, chiefly noticeable in the whites, will appear after a time (months or more) in prints which have not been thoroughly fixed or cleared in the acid baths.

Prints should have five minutes in each acid bath, and the third bath should be replaced by fresh as soon as it shows any tinge of color when a two-inch depth of it is viewed in a white dish by daylight.

Removal The yellow stain can be removed with a solution made by shaking up some bleaching powder with cold water, pouring off from the deposit and adding hydrochloric acid, a few drops at a time, to the solution, until it has a distinct chlorine smell. After a few minutes in this bath the yellow stain is removed, and the print only requires to be washed for about a quarter of an hour.

Physical Damage The image in platinum prints is held on to the fibers of the paper, not in an emulsion of gelatine or collodion as with other papers.

Thus the wet prints are easily damaged, particularly after hot development or in the acid baths. Drawing one over the other or against the bottom of the dish is liable to rub away the image, causing white patches on shadow parts.

This applies only to the ordinary papers—not to Japine platinotype, which has a hard surface. Japine prints, on the other hand, are almost brittle when bone dry and will crack if bent sharply.

Prints develop so quickly that there is no need to have more than one print in the developer at a time; and, as regards the acid baths, simply let them soak, and then lift singly into the next bath, beginning with the top one.

CARBON PRINTING

The carbon process differs so radically from other printing methods that the beginner who has not some acquaintance with it is bound to be confused by the diagnosis of failures which forms this chapter. The section on carbon printing in The Photo-Miniature, No. 108 provides a useful first primer in the process; but here let me say that the manipulation in its simplest form consists in (1) sensitizing a tissue (a gelatine-pigment mixture coated on paper) in bichromate solution; (2) drying that tissue; (3) printing under the negative; (4) applying the wetted tissue to a transfer paper; (5) developing in hot water, and (6) clearing and washing.

Thus the process is unlike others in that the material of the picture is there at the start. It is not formed by developing or toning, but is fixed only by exposure to light. That is one great factor of certainty in the process; the difficulties are largely of a quite different kind from those met in working other methods. Success in carbon printing depends upon attention to all of many apparently trifling details. Therefore it is necessary to lay stress on a number of points which may seem of minor importance.

The following notes refer to the single-transfer process, the form of carbon printing in which the beginner is recommended to become experienced before passing to double transfer, although practically everything which is said here applies to the latter process.

Sensitising Sometimes the dark coating on the paper (tissue) will melt or "run" in the sensitising bath.

The cause is that the sensitising bath is too warm. It should not be over 60° F. and, if necessary, should be cooled with ice. Failing ice, the bichromate bath may be made up with about one-quarter alcohol and three-quarters water, or better sensitising done with a spirit sensitiser which is brushed on the tissue, instead of the latter being immersed. This is a good method for the tropics, as it not only avoids "running" but makes tissue dry very rapidly.

Drying "Running" of bath-sensitised tissue during drying is due to too high temperature. Although tissue should dry fairly quickly (in about four hours), this should not be done by putting it in a warm place (i. e., not above 80° F.), but by means either of ample ventilation or an ample supply of drying agent in a closed box. Also tissue as it comes from the bichromate bath should be laid face down on glass and as much of the solution as possible pressed out with a bar squeegee, starting the stroke of the squeegee at one end; if started in the middle the result is liable to be a dark band across the face of the finished print.

Insolubility And this brings me to a matter which is the cause of probably half the troubles of the beginner in carbon printing, viz., the loss of condition of the tissue, before it is exposed and developed, which may be shortly described as "insolubility," especially as that is exactly what it is! The dark gelatine coating on the unsensitised tissue is very soluble. It dissolves off in hot water without any difficulty. If it does not, it is a sign that there is something radically wrong with the material. But, after sensitising, various unsuspected things can cause the coating to become partly insoluble without any regular exposure under the negative at all. Hence flat prints, failure to adhere to the transfer paper and to develop readily even in hot water.

Causes The main cause of this insolubility is improper drying of the sensitive tissue, i. e., too slowly or in a place where fumes from gas or a stove can get at it. For practical purposes there are two ways of drying tissue—in a big closed calcium-chloride box, such as I have specified under "Platinum Printing," or in a cupboard or darkened room where it gets a constant change of pure moderately warm air. The latter is more uncertain, wherefore I recommend the beginner to adopt the former. There you have the conditions for proper drying, viz., a cool very dry atmosphere, no light and no danger of contamination from gas fumes, since you can place the drying-box anywhere. In default of the

box, the best plan is to squeegee the sensitised tissues to ferrotype sheets, and clip up the latter in a room in which an open fire has been burning during the day. On either plan, tissue will dry, or it should, within 6 hours. Slowness of drying is another cause. If the tissue does not dry within eight hours, it is liable to become insoluble, even though other conditions are right for the production of good prints.

Exposure to Light also Tissue is practically insensitive when wet, but becomes rather more sensitive than print-out-paper as it approaches dryness. It should be just bone dry.

Also, too long keeping of the dry tissue, which will work well within little more than a week of sensitising if kept in the ordinary wrappings. It will keep for months if kept in a well-charged calcium tube. The latter should be of the drawer pattern, with a spring to hold the sheets flat, not a cylinder which gives the tissue such a curl that there is difficulty in getting good contact against the negative.

Still another cause is an acid sensitising bath due to bichromate of bad quality. Every twenty ounces of sensitiser should have had from 15 to 30 minims of strong ammonia added to it.

Transferring Failure of the tissue to adhere to the transfer paper when the print comes to be developed is due to: (1) Insolubility (see above); or (2) to letting tissue soak too long before squeegeeing to transfer paper. On putting in water, tissue first curls inward and then begins to uncurl itself straight. The beginning of the latter stage is the time at which to squeegee to the transfer paper; or (3) to too short a time between squeegeeing and development. Fifteen minutes is enough as a rule; 30 minutes, for rough transfer paper.

Paper Backing Sticks Difficulty in stripping off the paper backing preparatory to developing the print arises from insolubility (see above) or to great over-printing. If the latter, the margins of the backing under the safe-edge will come away, but the rest will stick.

Frilling Loosening of the edges of the picture from the transfer paper arises from the causes mentioned in the previous paragraph, as also from omitting to "safe-edge" the negative, i. e., to shield edges of the tissue from action of light during printing. An effective safe-edge is simply a quarter-inch strip of black gummed binding fixed round the margin of the glass-side of the negative.

Separate Blisters on Prints Careless squeegeeing of tissue to transfer paper. Air-bells between the two give rise to blisters, particularly when development is forced by the use of extra-hot water. It is worth while to learn the dexterity needed to squeegee evenly and so avoid this trouble.

Reticulation This is a network of minute bubbles over the whole surface of the print, and is most liable to occur in hot weather. A chief cause is forcing development too long in hot water, in the endeavor to get down the depth of an over-exposed print. Also due to too rapid drying (by warmth) of the tissue after sensitising; to squeegeeing tissue to transfer paper in too wet a state; to soaking tissue too long before squeegeeing; and the use of too much ammonia in the sensitiser. The remedies are obvious where the cause is known.

Prints too Light Under-exposure as the result of misjudging density of negatives or use of weak or exhausted sensitising bath. Such prints should be developed in water at about 80° F. If still too light when finished, they may be intensified by dipping in a fairly strong bath (20 grains per ounce) of potass permanganate, then washing, drying and repeating the process, if necessary.

Prints too Dark Over-exposure; or leaving tissue too long between printing and developing. Unless the printed tissue is kept perfectly dry, the action of the light goes on in the dark, with the result that a correctly exposed print may turn out overdone. Unless the development of the prints to be taken in hand within an hour or so, exposed tissue should be put in a calcium-chloride box, and so protected from this continuing action.

Flat Prints Due to insufficient vigor in the negative, can be remedied by using a weaker sensitising bath. A good formula for summer work is: Bichromate of potash, 3 ounces; distilled water, 100 ounces; glycerine, 30 drops; salicylic acid (dissolved in hot water), 15 grains; carbonate of ammonia, 60 grains. Another formula is: Ammonium bichromate, 1½ ounces; sodium carbonate, ¼ ounce; water, 25 ounces. For use take one ounce of this and add two ounces Columbian spirit.

Hard Prints Too much contrast in the negative, calling for an extra-strong sensitising bath or for exposure of the tissue for a second or two to the sun before putting in the frame. Only a very brief "sunning" suffices to make a marked improvement in the quality of the print.

Lack of Half-Tones The chief cause is too weak or an overworked bichromate bath. Other causes are drying tissue too quickly, keeping too long after sensitising, or leaving too long in wet contact with transfer paper. Under-printing accentuates the defect.

White Spots Air-bells adhering to tissue during sensitising or imprisoned between tissue and transfer paper. In the latter case, they usually occur with rough transfer paper, which should be well soaked before squeegeeing; an hour's soaking in tepid water is not too long for such papers.

Dark Spots or Patches Due to drops of water splashing on to tissue whilst in contact with transfer paper between exposure and development. Most liable to occur in hot weather.

Unsharp Prints Due to curled or buckled tissue, which it is difficult to get flat against the negative. Tissue should be pinned down or squeegeed to a support for drying, and kept flat under slight pressure until printed. Tissue which is so curled or buckled that it is unmanageable is best put under pressure in a frame for an hour or two before use. If the curling is due to extreme dryness of the tissue, leaving it for a while (unwrapped) in an ordinary drawer will put matters right.

PRINT-OUT-PAPER

No useful purpose is served by dealing with this paper at a length which is easily possible, for among the amateurs of almost every country it has been supplanted either by development or self-toning papers. Used in the simplest way, viz., toning it and fixing it at the same time in a combined bath, print-out-paper provides very little occasion for failure; the chief mishaps are too light or too dark prints from the causes already explained in the section on self-toning paper. But much the finest results on P. O. P., as regards both tone and permanence, are gotten by toning and fixing in separate operations, and in working that process (usually with a toning bath of gold and sulphocyanide) there are a number of pitfalls, to the avoidance of which I may best devote the space at my disposal.

Refusal to Tone

If prints remain reddish in color in the toning bath, the cause is most usually a bath made up with too little gold or exhausted by previous use. Another cause is an acid condition of the bath from bad chemicals or from alum used before toning, in order to harden the prints, and not properly washed out. A drop or two of soda-carbonate solution in the bath will sometimes set matters right.

Refusal to tone is also a certain result of contamination of the toning bath by hypo from chance splashes of fixing solution or dirty dishes.

Patchy Toning

Due to not keeping prints constantly on the move in the toning bath—straight edges to the patches will sometimes be seen in bad cases of quiescent over-crowding—and to touching surfaces of the prints with the fingers.

Double Toning

This is blueness of tone in the light parts of the picture, whilst the shadows are of warm tone. It comes from a bath which tones too quickly, and is more liable to occur with a sulphocyanide bath which has not stood for a few hours after making up. A very little soda sulphite—2 grains in 20 ounces of the toning bath—goes a long way toward preventing this defect.

Various Tones in Batch This is perhaps the most common defect in making P. O. P. prints. The negative largely affects the tone, but a chief cause is passing the whole batch of prints, a few at a time, into a bath just about sufficient in quantity to tone the lot. That means that the bath gets weaker and weaker as prints are toned—with the result that the tone varies. Instead, divide up prints into lots of such size as can be conveniently handled. Tone one lot in the requisite amount of bath and then throw the latter away, starting more prints in a fresh lot of bath. See the directions of the Eastman Company for toning Solio on this system.

Tone too Warm Bath too weak in gold or prints not toned long enough. With the sulphocyanide bath, prints should show no sign of redness in the shadows when held up to the light and looked through.

Tone too Blue Keeping too long in the toning bath; or more probably letting prints accumulate in a dish of not very much water. Toning then goes further by reason of the bath carried over with prints. Best to rinse in running water, or to transfer prints to a stop-bath of soda sulphite, 50 grains in 10 ounces water.

Loss of Depth in Fixer Too rapid toning; or fixer too strong (more than 3 ounces hypo in 20 ounces); or fixer made up with acid or alum (use only plain hypo); or prints left too long—10 to 15 minutes is ample.

Brownish Stains If these appear before fixing, the cause is traces of hypo reaching the print during the wash between toning and fixing. Yellowish or brownish stains which appear soon or long after prints are finished are simply due to incomplete fixing.

Black Spots Rust in wash water, prevented by filtering water through flannel tied to the faucet; or particles from metal cutting-shapes when prints are trimmed before toning; or particles of dry developer dust (e. g., pyro, metol, or amidol) settling on prints.

FAILURES IN ENLARGING

Here I am concerned only with the failures which may arise in the use of enlarging apparatus. Defects due to faulty development or fixing of the gaslight or bromide paper are broadly those met with in contact printing, and have been considered in the preceding pages.

Most of the troubles which are met in the enlarging process occur in the use of a condenser lantern—the most efficient pattern of enlarger, but one calling for a proper understanding of its various parts. With the much simpler enlarging boxes, used with day or artificial light, there is scarcely any possilibity of going wrong apart from mistakes in exposure. On the other hand, the scope of these forms of apparatus is far more limited than that of the lantern as regards enlarging upon a large or a small scale, from a part only of the negative, or in controlling the result by shading, or masking during exposure.

Unsharp Enlargements Naturally, the sharpness of the picture suffers when it is enlarged; but many negatives made with high-grade lenses, and particularly those in quite small cameras, will stand a great degree of enlargement without there being any cause for complaint as regards sufficient sharpness. A vest-pocket negative measuring 45 x 60 mm. (1¾ x 2¼ inches) should enlarge easily to 5 x 7 inches (that is 3 times), if not to 8 x 10 or larger, without the enlargement approaching fuzziness.

The Negative A prime factor in this is the kind of negative. It should be thin, clear, and brilliant, the result of correct exposure and normal development. Of two negatives, taken under identical conditions, but one made as just stated while the other is "thick" from over-exposure and full development, the former will yield a sharp, crisp enlargement where the latter will not. The difference is due to the spreading of the image, which takes place on development of over-exposures. Very likely it will not be marked in contact prints, but it is very pronounced in enlargements. Also it is more difficult

to focus the enlarged picture from such a negative on the easel of an enlarging lantern.

Movement During Exposure

It is scarcely necessary to mention shake of the apparatus during exposure or shift between focusing and exposure, as a cause of unsharpness; yet I have seen lanterns in which such poor means were provided for holding the negative in place that it could rattle if the apparatus was jarred and so could easily move in the interval after focusing had been done. The negative-holder should be fitted with springs or clips which press the negative firmly against some solid support, and the same applies to the holder itself. Remember that a very slight movement of the negative makes a lot of difference to the definition of the enlargement, especially when enlarging on a fairly great scale—four times or more.

The Lens

The lens may cause unsharpness in several ways. The objectives supplied with cheap stereopticon lanterns are no good for enlarging. Though the picture on the easel can be sharply focused, the result on development is unsharp, due to non-achromatism of the lens, as explained in the section of this monograph on unsharp negatives.

Even high-grade lenses will exhibit this defect when the inclosed type of arc lamp is used in the lantern. For this light, the old-pattern R. R. doublet lenses answer well as a rule, and their aperture of *f*/8 is quite big enough for this high-power light.

Dirty Lenses

Then dust or moisture on the surface of the lens will cause unsharpness, as can also raising or lowering the lens too far on the lantern front. Unsharpness from either of these causes will make itself evident on the easel at the time of focusing. Dust or moisture will cause general unsharpness, whereas, with a decentered lens, the effect will be on part of the enlargement only, and will not occur at all if the lens happens to have ample covering power, although they may give rise to trouble of another kind to which I will now turn. It is a frequent cause of failure with the beginner in enlarging.

White Corners

With a condenser lantern, several things may give rise to parts of the picture being cut off from the enlargement, leaving bare white paper.

The occurrence of these white places at the corners of the enlargement indicates that the negative is not fully illuminated by the condenser. This may be due to raising or lowering the negative in its holder too far, in the aim of bringing the enlarged picture into position in the easel. Most enlarging lanterns allow very little latitude in this direction if one is using the whole of the negative. The proper course is to place the negative central with the condenser, and to fix the paper over the image (as seen through the yellow cap) in the easel.

Even with the negative central, the extreme corners are left uncovered by the condenser, owing to the latter not being close enough behind the condenser. This is a fault of the apparatus, which it is often possible to remedy by making a new carrier-frame for the negative of thickness to bring it a quarter of an inch or so farther back.

Bad adjustment of the light will cause faulty illumination. When the enlarged picture has been roughly arranged on the easel as regards size and sharpness, withdraw the negative and adjust the light until you have a bright evenly lighted disc without any patches of shadow. With some lamps, and particularly when the lens is only of moderate aperture such as $f/8$, it is impossible to get an even disc except by putting a sheet of ground-glass behind the condensers. The larger the actual area of the source of light and the smaller the actual diameter of the lens stop, the greater the necessity for the ground-glass. A few trials (without a negative in the lantern) are worth while; they will show what may happen in actual work. And remember that an adjustment which is right for one degree of enlargement may not be right when the scale is altered. It is impossible to give set rules—so much depends on the lamp and the lens—but an hour spent with the lantern will show just what the pitfalls are.

Flat Enlargements Apart from over-exposure of the paper, faulty development, etc. (the causes I have noticed in the preceding chapter of this story), a flat result may arise from too powerful a source of light. A delicate negative, if enlarged with an arc light, will yield a result which is wretchedly flat as compared with that obtained with incandescent gas, an incandescent focus bulb, or one of the illuminating boxes, gas or electric. And, even with a moderate-power light, the paper may not be vigorous enough for the negative. Many delicate negatives are unsuited for enlarging on bromide, but require a soft or even a vigorous grade of gaslight paper. Still another cause of flatness is fogging of the paper while in the easel, through stray light in the room or, as can occur, by use of an "unsafe" yellow cap on the lens.

Hard Enlargements These, on the other hand, come from excessive vigor in the negative, or from too contrasty a grade of paper. A more powerful light will do something to counteract the former in conjunction with weaker development; the remedy for the latter is obvious.

FAILURES IN MOUNTING

I conclude these notes on the mishaps which the beginner may encounter with a chapter on mounting failures; for my experience is that mounting is largely shirked by the amateur. The slip-in mounts provide an easy way out of difficulties, it is true; but, if you make it a practice to use stock sizes and patterns of mounts, you will miss a good deal in the way of getting the most effective pictures for your own walls or for gifts to friends, whilst you cut yourself off from chances of awards in competitions and exhibitions. So then to the chief failures—and the why of them in mounting.

Prints do not Hold One common cause of this is applying the mounting paste to the *dry* print. When dry, the print cannot take up the paste into its pores as it can when wet. Moreover, it is difficult to press a pasted dry print into even contact.

If you are mounting any number of prints, lay the lot, face down, on a sheet of glass, one on top of another as they come from the wash water or after soaking them. Then press out excess of moisture with a roller squeegee, and start brushing paste over the back of the one on top.

Working in this way, with either stiff dextrine paste (e. g., Higgins') or the thinner home-made starch paste, you will avoid all mountant getting on the face of the print, and you will not need to press prints down on the mount; only to smooth gently into contact with a squeezed sponge or wet chamois leather.

Thick Papers

If prints are on thick paper, a strong adhesive like Higgins' or thin hot glue should be used. For thin papers, there is nothing better than freshly made starch mountant.

Warping of Mounted Prints

There is no way to avoid this trouble entirely when using mounting pastes, for it arises from shrinkage of the wetted print as it dries on the mount, this shrinkage drawing the mount into bow shape.

But it can be minimized by using as little mounting paste as possible; by having the print with as little moisture in it as you can, consistent with its being limp; and, chiefly, by using a mountant also made up with the minimum of water.

The smooth dextrine pastes are good in this connection; so also is a mountant made by soaking 4 ounces of gelatine in 16 ounces of water, liquifying by standing the vessel in boiling water, and then adding slowly 5 ounces of denatured alcohol and 1 ounce of glycerine to the mixture.

This mountant is used hot, and a very thin film suffices. In fact, a good way to apply it is to dip a sheet of ground-glass in hot water, let it drain for an instant, and then brush the hot mountant over it. Then lay the back of the limp print on the coated glass, rub over for a second or two with a sheet of thin rubber laid on it, then lift off and rub down in place on the mount.

Even very thin mounting boards or cards will show very little warping by this method.

The reader may ask why I advise mounting prints wet, in view of its warping effect on mounts. But mounting dry, except by the shellac-tissue process, is a very awkward and tedious business, and in any event, the moisture of the mountant has still a considerable effect in the same direction. For mounting prints dry, as good a plan as any is to run a line of fish-glue or "Seccotine" around the outside edge, and to press firmly in contact with the mount.

Dry-Mounting Failures In theory, the dry-mounting process is the simplest thing imaginable. You lay a piece of adhesive shellac tissue between print and mount, press the whole for a few seconds in a hot-press, and there you are, with the print firmly and evenly attached to the mount. Yet I have no doubt my readers who have used the commercial small dry-mounting presses have discovered that there are pitfalls in the process.

Pitfalls Let me deal with these, prefacing what I have to say with the remark that it is dampness of mounts or prints which is responsible for nearly all the failures which are met with in process. The reason for this is that damp gelatine prints in the confined heat of the press become sticky and also shrink, whilst mounting-boards, especially if thin and of poor quality, likewise warp and buckle as the result of contraction. If you eliminate moisture from both materials, you rid the process of the major part of its difficulties.

Remedies For this, it is only necessary to keep prints and mounts in a warm dry place for an hour or two beforehand, spreading them out on a table or racking them edgewise on some form of stand—at any rate exposing them freely to warm dry air. On a small scale, the use of an upper shelf in a living-room will serve well enough for avoiding the presence of injurious moisture.

Prints do not Stick Prints will not stick if the temperature of the press is too low. About 150° F. is right for prints on the customary thin paper; those of stouter substance will usually require it hotter—180° to 190°.

Remember that a cold zinc plate inserted into the press will lower the working temperature on the print, and will thus call for longer pressure, say 10 to 20 seconds. When the zinc plate is once warm, as it is in regular work, pressure for 5 seconds is ample.

In connection with temperature, remember that there is only one right way to place zinc-plate mount and cardboard in the press. The small presses sold for amateur use are mostly heated from below,—that is, the hot plate is the base. The zinc plate is laid on this base, then the mount (with the print attached to it) *face down*, and then the sheet of card. If the press is one heated from above, then the order is the reverse: the zinc plate on top, then the mount, *face up*, and the card at the bottom. Wrong placing of the three items means lower effective temperature, since the cardboard is a bad conductor of heat.

Too high a temperature will lead to non-sticking, for as you approach 250° F. the shellac keeps in the melted state for some seconds after removal from the press, and therefore the print is unlikely to remain attached at all points.

Thick Papers

With thick gelatine prints, such as heavy-weight bromide or gaslight, there is difficulty in getting firm adhesion, due to the gelatine surface contracting in the press and causing the print to curl away from the mount during the few moments whilst the shellac has not perfectly set on removal from the press.

The remedy is to relax pressure only just enough to allow of the mount (and the zinc plate resting on it) to be withdrawn, and immediately to press the zinc down with a thick duster and so to keep the shellac in contact with both surfaces while it cools.

Prints Stick to Zinc Plate

This is simply due to dampness of the prints. On the other hand, if prints are made too dry, they often curl to an extent which makes them unmanageable for dry-mounting. It is then almost impossible to trim print and tissue to exactly the same size, and there is much trouble also in placing the print with its attached tissue in correct position on the mount.

The remedy for this difficulty is to dry prints flat by letting them first dry in the ordinary way and then, whilst they are still without any tendency to curl, rolling them (face outward) round a cylinder such as a broomstick. As many as are to be mounted are rolled in this way, one on the top of another, and a sheet of paper then rolled around and tied with string. The wooden core of the roll can now be pulled out and the roll of prints put aside in a warm place for a few hours. On untying them, it will be found that each is flat—or rather has a slight curl in the other direction—and is very easily handled in attaching tissue, trimming, placing on mount, and hot-pressing.

Markings on Prints

With developed prints, slight dampness gives rise to markings, due, no doubt, to sudden further drying of the emulsion film. The best thing is to sponge the surface lightly and, when it has dried, to rub over with pumice powder if a matt print, or with cerate or metal-polishing paste if semi-glossy.

With print-out (Solio) prints, the markings are often in the shape of patches, showing distinct alterations in tone. Too hot a fixing iron will also cause them. In fixing tissue to the back of the print, the iron should not be so hot that it glides, nor so cold that it sticks, when fixing the tissue. It is a good plan to keep a thick bit of iron plate (heated by a small gas ring) on which to rest the fixing iron. The gas can be easily adjusted so that the fixing tool comes to the right temperature every time it is laid on the iron plate. Print-out prints which have become marked cannot be remedied by any means that I know.

Edging of Tissue Around Prints

A print which is somewhat damp will contract in the hot press; not so the shellac tissue, which then shows as a narrow line around the mounted picture. The same unsightly effect is caused by careless trimming of the print and tissue together, that is, by the two not registering exactly. If the print has much curl in it, it is none too easy to trim in proper register with the tissue. If there is any trouble in this direction, dry prints in a roll as already directed.

By means of a sharp knife and a steel straight-edge, the protruding edge of tissue can sometimes be trimmed away from the mounted result.

Loose Edges or Corners

Edges or corners of the print which are found to be separate from the mount after hot pressure are usually due to tissue having been accidentally folded or broken before placing in the press. With a little skill, you can raise the print and insert a strip or fragment of tissue under it, fixing it to the mount with the iron. Then lay the print over it, trim off the protruding tissue with a sharp knife and straight-edge, and pass the whole through the press for a second time.

Buckling of Mounted Prints

Although one chief merit of the dry-mounting process is that it avoids cockling of the mounted prints, yet there are limits to its power in this direction. If the finished result does not lie flat, the cause is generally the use of a mount which is both too thin and of too pulpy quality. The result is that, while the part covered by the print remains flat, owing to the shellac stiffening, the margins warp and buckle, after a time, due to absorbing moisture.

George E. Brown

BOOKS

Several recent issues of The Photo-Miniature deal with the branches of work the chief pitfalls in which we have considered in the foregoing pages. They are:

Modern Methods of Development (The Photo-Miniature, No. 139). 25 cents.

Lens Facts You Should Know (The Photo-Miniature, No. 140). 25 cents.

All About Enlarging (The Photo-Miniature, No. 144). 25 cents.

Trimming, Mounting, and Framing (The Photo-Miniature, No. 102). Illustrated. 25 cents.

Remedies for Defective Negatives (The Photo-Miniature, No. 143). 25 cents.

Notes and Comment

Columbia University, New York City, announces a set of two courses in Photography for the Winter and Spring Sessions of 1916–17. The first course will cover the general principles of photography, and the second will deal in detail with photographic processes. The classes are to be held weekly in the evening, and the fee for each course is $12, with a University fee of $5 for the academic year. Dr. M. F. Weinrich, of the Department of Physics, will be the instructor in both cases. For further information apply to the Secretary of the University.

The reader who has planned to get "one of those fine hand-cameras they make in Europe" for his summer's work, has an extraordinary opportunity in the Clearance Sale of high-grade foreign cameras, announced on another page of this issue, by Dept. M., Allison & Hadaway Corp., 235 Fifth Avenue, New York. Think of an Adams 2½ x 3½ Roll-Film Vesta, with Zeiss Tessar *f*/4.5 at $80. The Sale is for the month of May only. See the announcement, and act on it before it is too late.

"What about the many 'metol substitutes' now so freely offered at absurd prices?" was the question put, a few days ago, to one of the leading importers of metol before the war. "We offer no metol substitutes," was his reply, "simply because we cannot find one which is reliable, and we don't believe in these absurdly high prices."

In the May issue of *Studio Light*, the Eastman Kodak Company issues a warning against these "substitutes" under the caption "Sweeten to Taste, or How to Make a Substitute Developer." From a recent analysis of one of these "substitutes" the Kodak Park Research Laboratory found it to be made up as follows: Metol,

10%; Hydroquinone, 16%; Sodium sulphite, 30%; and cane sugar, 33%. Other constituents, chiefly water, of no value as developer, 11%. This developer was offered at over $30 per pound. Figuring Metol at $50 a pound (it used to be $10 before the war), you could make up this "substitute" developer for less than $6.50 per pound. Beware of the "substitute" developer, unless it has the name of a reliable house behind it. Even then care should be exercised, as we are informed by G. Gennert, the American agent for Hauff's Metol, that worthless "substitutes" are being offered in second-hand Hauff Metol bottles bought up for this purpose.

The last word in hand-cameras is the new Auto-Fixt-Focus Camera, for roll-film 2¼ x 3¼, offered by Herbert & Huesgen Co., 18 East 42nd Street, New York, at $75. This is a real de-luxe hand-camera, built with the utmost care from the finest materials, and embodying all the essential features approved for successful hand-camera work, but free from the vexatious mechanical and operative complications so often found in hand-cameras of this class. Send to the makers for the descriptive booklet which tells of this camera in detail, with illustrations of its novel features.

A Memorial Fund, to keep alive the memory of Dr. Ferdinand Hurter and Mr. Vero C. Driffield, is being considered by the Royal Photographic Society of Great Britain. Professor E. J. Wall, Syracuse University, Syracuse, N. Y., is the Treasurer of the Fund for America.

Messrs. Hurter and Driffield laid the foundation of all modern scientific photography. It is to be hoped that the memorial will take the form of a reprint of all the scientific papers published by these distinguished workers, supplementing the monograph which Mr. Driffield contributed to The Photo-Miniature Series some years ago (No. 56 of the series, now out of print). The Eastman Kodak Company has promised $1,000 to the Fund. All subscriptions, no matter how small, should be sent to Mr. Wall, addressed as above.

16

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Photographic Chemistry

The simplifying of photographic manipulation demanded by the universal use of photography as a hobby, and the almost general use, by amateurs and professionals alike, of ready-prepared materials and chemical solutions for obtaining specific results in everyday work, have together largely eliminated the oldtime necessity for a practical knowledge of chemistry by the photographer. Nevertheless the common and unquenchable desire to know the "why" as well as the "how" of photographic methods shows itself in the continual demand for a handbook which will tell the inquirer something about the chemistry of the substances and processes used in photography. This, with the fact that at present there is no elementary handbook to photographic chemistry in English available for American photographers, is sufficient justification for this, the third monograph on the subject published in THE PHOTO-MINIATURE SERIES. It is interesting to note that courses in photographic chemistry are now given at the Universities of North Dakota, Wisconsin, Minnesota and Syracuse. Columbia University, New York, has announced a course of lectures on photographic processes for the forthcoming winter season, and it may be that the subject is dealt with in other colleges outside of my information. The monograph here following has been prepared by Fred H. Heath, Ph. D., of the University of North Dakota, and is the outcome of a series of lectures given by him in

the Department of Chemistry at that University during the past two or three years. Its purpose is to give a simple outline of the chemistry of the photographic processes in daily use among amateurs and professionals, from the making of an emulsion to the finishing of the print. To deal with such a subject comprehensively or adequately would, of course, call for a volume many time larger than is possible in this Series. The brevity of Mr. Heath's work and the directness and simplicity with which he handles his subject may, however, atone for lack of length and depth. To those who, after a careful reading of these pages, still thirst for longer and deeper draughts of chemic learning, I commend "The Theory of the Photographic Process" by Mees and Sheppard, and "Photo Chemistry" by Sheppard, both published by Longmans, Green & Co., of New York, and both as thoroughly interesting as they are unreadable.—EDITOR.

It is the common fault of the practical photographer to overlook the possibility of improving his method by a better understanding of the scientific nature of the methods which he uses. There is also the tendency of the man who understands the theory of the process to overlook or underestimate the value of the practical side of the subject. The ideal situation is a middle ground, and for the best results there ought to be more coöperation between theory and practice.

Many physical effects are intimately associated with the common operations of photography, but after the exposure of the plate a larger proportion of the factors involved are of a chemical nature.

Photographic Emulsions

In the manufacture of all photographic plates, films, and papers the substance that is affected by light is some salt of silver or some mixture of salts of silver, with the addition of other materials for producing desired effects. On a photographic plate it is necessary to use something to hold the sensitive silver compound in place on the surface of the glass. Plates are coated with this mixture while the latter is in the liquid or semi-liquid state, and then the plate is allowed to dry.

Previous to the coating of the plate the materials used for the purpose are subjected to a long and complicated chemical process so as to get them into the proper condition for use. Some knowledge of the nature of the materials used and the methods of manufacture of plates will give a better understanding of their use. The silver salt used for the coating of plates, films, etc., is in a finely divided form and it is held in place on the plate by the use of gelatine that has been mixed with it. Gelatine will melt when heated in the presence of water, and then on cooling and drying there is formed on the glass a thin layer of gelatine in which the sensitive silver salt is held. Such a mixture of the insoluble grains of silver salt with water and gelatine constitutes an emulsion.

In the early days of photography, collodion (guncotton in ether) was used as the emulsifying material. At present this has been superseded by gelatine, except for some very special purposes. Collodion emulsions give sharp fine-grained images, but are not very sensitive to light. Gelatine emulsions are much more sensitive to light, are less sensitive to changes of temperature or to mechanical shock, and they are very easy of operation, with other practical advantages.

The Materials

The materials for the preparation of the modern emulsion are: Silver nitrate, pure water, potassium bromide, and, in many cases, other salts of potassium or ammonium, such as the iodide or chloride. By mixing solutions of silver nitrate and potassium bromide we get the insoluble silver bromide and the soluble potassium nitrate (commonly known as saltpeter). If we use both potassium bromide and ammonium chloride together with the silver nitrate, then we get a mixture of insoluble silver bromide and chloride. Of course, all these operations must be done in a safe red light similar to that used for the developing process.

If the precipitation of these salts is carried out in the presence of gelatine, then the insoluble silver salts do not settle out but remain suspended in the liquid indefinitely, and in a very finely divided form. The resulting mixture is an emulsion, and for some purposes

it can be used as it is, but for ordinary use a further treatment of it is necessary. For the making of a successful emulsion, great care and skill are required on the part of the operator who prepares it, in the selection of the gelatine, in the proportions of silver bromide and silver chloride (or silver iodide) used, and in the preparation of these salts, their subsequent treatment, and the coating of the plates.

Comparisons For plate-making, silver bromide is the most sensitive to light; then comes silver chloride, and last silver iodide. Most plate emulsions carry a large proportion of the bromide, but some chloride or iodide is often added. Addition of silver iodide to a bromide emulsion improves the general quality of it and tends to clearness and freedom from fog. A greater proportion of bromide tends to a faster plate.

The ordinary plate emulsion in its finished form on the plate generally carries about 50 to 55 per cent of the silver salt, about 40 per cent of gelatine, and the remainder is water. It is of the greatest importance that the finished emulsion shall contain no silver nitrate if the emulsion is for plates or films. Excess of potassium bromide seems rather beneficial, as it prevents thin negatives and tends to reduce fog. A large excess of silver iodide is thought to favor solarization. Excess of potassium bromide will give very dense negatives and fast plates. The use of citric acid in the emulsion gives warmer tones. Silver phosphate gives a very long scale of gradation (little contrast).

Emulsion Formulas The following set of emulsion formulas will illustrate the general conditions and proportions of ingredients taken in typical emulsions:

Chloride Emulsion for Gaslight Papers or Slow Plates. *A*.—Common salt, 28.8 grs.; hard gelatine, 38.4 grs.; distilled water, ⅘ oz.; hydrochloric acid, 1 drop. *B*.—Silver nitrate, 57.6 grs.; distilled water, ⅕ oz. *C*.—Hard gelatine, 38.4 grs.; distilled water, 1 oz.

Dissolve *C* at 120° Fahr., add *B* at the same temperature, and then add *A* at the same temperature. Allow to stand for ten minutes, then cool and allow to set.

This emulsion works well for gaslight papers or slow plates for lantern-slide work.

Chloro-Bromide Emulsion. (Wellington's Formula.) This gives better blacks than a pure chloride emulsion and warm tones as the exposure is increased. Increase in the relative proportion of chloride gives more contrast.

Potassium bromide, 192 grs.; common salt, 96 grs.; citric acid, 480 grs.; hard gelatine, 672 grs.; distilled water, 10 ozs. Heat at 150° Fahr. and add, silver nitrate, 480 grs.; distilled water, 10 ozs.

Heat the mixture at 150° Fahr. for ten minutes, then cool and set.

Emulsion Problems

One great trouble in the making of all photographic emulsions is the formation of a coarse, sandy-grained silver salt. This form of the bromide may be changed to silver by the developing agent without the action of light. Preparation of the silver salt by gradual precipitation in a dilute solution tends to prevent this effect. The fineness of grain depends considerably upon the proportion of the gelatine used and upon its quality. Too much gelatine, or too hard a variety (high melting-point) will render it difficult to get a high-speed emulsion. Too little gelatine gives too granular a deposit of the sensitive silver salt. To increase the contrast of the plate emulsion, it is the common thing to add to the emulsion traces of copper chloride and other chemicals to effect this result. Calcium chromate, cobalt, and nickel compounds, etc., are also used for the same reason where contrast is desired in an emulsion.

The Ripening Process

When first mixed the emulsion is very slow (insensitive to light), no matter what formula is used. In this condition the emulsion would not be suitable for any plates except lantern-slides or other slow plates. The next process is that of ripening or increasing the sensitiveness.

Long ago it was discovered that, other conditions being equal, the sensitiveness of the emulsion was largely dependent upon the size and character of the grains of the silver bromide in it. Up to a certain point,

the larger the grains the faster the plate. The process of ripening, or enlargement of the grains of the emulsion, is brought about either by the application of heat, by the action of ammonia, or by both these methods.

A similar process is often used by the chemist for enlarging the grains of precipitates. A small particle of a substance is more soluble than a large one under the same conditions. If the liquid is heated, all particles present will dissolve to a larger extent than before. On cooling, the coarser particles increase in size by deposition from the solution. In this way the particles of silver bromide are commonly enlarged from a diameter of about one-twenty-five-thousandth of an inch to one-three-thousandth of an inch. The ripening process will proceed slowly in the cold after it has been started by heating. There is a change in color of the silver bromide at the same time. Ripening increases the sensitiveness by a hundred- to a thousand-fold. The ripening process renders possible the modern fast plate and the wonderful things accomplished in speed work and motion-picture photography. The great difficulty is to avoid the fogging point and to keep the emulsion from disintegration.

For the ripening of emulsions two general methods are in use. The first of these is the acid (boiling) process, and the second is the ammonia process. The first of these is much simpler and easier to use but it cannot give a very rapid plate. The second process is harder to manipulate but it is capable of giving plates of extreme speed. Print emulsions may be ripened by methods like those used for plate emulsions.

The Acid Method of Ripening

The acid (boiling) process ripens the emulsion by heating it with the addition of acid. It is used mainly for the making of print emulsions and emulsions of slow plates. Sometimes the mixture is not boiled, but it is kept hot for some time and stirred. Too long a time of heating or a poor grade of gelatine may cause deterioration of the emulsion and bad results. The degree of ripening by this process is limited in practice to a speed of about 200 on the Hurter and Driffield scale of plate-speeds.

The Ammonia Method of Ripening

The ammonia process involves the addition of ammonia to the emulsion in an amount sufficient to dissolve a part or all of the silver bromide that is present. Sometimes ammonium carbonate is used in place of ammonia. The requirements for this process are,—a pure grade of gelatine, not too high a temperature, not too long a time of heating, care as to the relative amount of gelatine used, etc. All these factors combine to determine the character of the finished emulsion. Even the purity of the water used is of the greatest importance. Too much ammonia will decompose the gelatine or cause too great contrast in the finished negative. Too high a temperature causes fog. Decrease in the proportion of gelatine gives more speed. Ammonium carbonate in place of ammonia gives ripening without too great contrast.

Washing out the Soluble Salts

After the process of ripening the next thing is to remove the salts present. In the preparation of silver bromide from silver nitrate and potassium bromide we have formed in the emulsion the silver bromide and potassium nitrate (saltpeter). For the successful working of the emulsion it is very necessary that all such soluble substances should be removed. There are two ways of bringing about this result. One way is to let the emulsion "set," cut it up in small cubes and soak these in water, and the other is to run the warm liquified emulsion through a centrifugal machine similar to a cream-separator. If the centrifugal method is used for the separation of the ripened silver salt, then the latter is mixed with the proper quantity of gelatine and the mixture melted together for the correct proportions of the finished emulsion. The latter is then coated on to the plate.

Gelatine

The character of the plate is so greatly affected by the quality of the gelatine that a consideration of the latter is of importance.

Glue and gelatine are closely related substances, but the latter is a much more highly purified article. Gelatine is made from bones. The latter are first boiled

with acid to remove all lime. The residue that is left is boiled with water, then with alkali, and finally treated with steam. A good grade of gelatine should contain no fat, and a 4 per cent solution of it should "set" at 68° Fahr. Long heating lowers the setting power of gelatine. There are different grades of gelatine,—hard and soft. The hard gelatine is better for summer use as it holds to the glass better than the soft gelatine, and it holds to the glass better during the process of fixing. Soft gelatine gives more rapid development and less tendency to fog. For most emulsions it is the custom to mix together the hard and soft grades of gelatine in varying proportions.

An understanding of the nature of the emulsion and how it acts toward liquids is of fundamental importance to an intelligent use of the photographic plate.

Some Properties of Gelatine

Gelatine belongs to the class of substances known to the chemist as colloids (not crystalline bodies). It is a property of such substances that they allow solutions of sodium carbonate or sodium sulphite, etc., to diffuse through them but do not permit easy passage of other colloids.

When a solution of gelatine is allowed to set, a jelly is formed and the latter consists of a cellular structure something like that of a sponge. Through this cellular network a developing solution can diffuse and finally pass through the walls of the cells themselves. Diffusion into the passages of the network is relatively rapid, but the passage of the solution through the cell-walls is a much more gradual process. In the case of a photographic emulsion, the grains of silver bromide (or other silver salt) in the solidified mass occupy the cells and are surrounded by the gelatine walls. Not all the grains of silver bromide in a given emulsion are of the same size, but they do not differ greatly.

By the use of the microscope it has been shown that during the process of development the grains of silver bromide put out filaments, and these may weaken the walls of the cell and allow more easy access of the developing solution. Before development can occur, it is necessary that the developing solution shall diffuse

through the network of the emulsion and then the chemical action of the developer itself changes the silver bromide to metallic silver. The latter effect is more rapid than the diffusion. Rate of diffusion and rate of development each increases with rise in temperature, and as a result the developing process is more rapid. The carbonate or other alkali used in the developing solution opens up the pores of the gelatine and so increases the rate of development. This rate of development, the kind of developing agent used, the amount of sulphite, the temperature, and other factors, all unite to determine the character of the finished negative, so it is not to be expected that careless methods will produce the best results.

The Action of Developing Agents

At the present time a great number of chemical products may be classified as photographic developing agents. Some substances have been so used in the past and later on have been displaced by other substances that proved to be more efficient or more convenient. The cost, chemical behavior, suitability, keeping powers, and character of the negative produced, are the factors to be considered.

Most of the substances at present used as developing agents are quite complex chemical compounds, and the manufacture of them on a commercial scale involves chemical problems which demand a high degree of chemical skill. Much has been heard recently about the lack of materials in the United States for such manufactures, but this country probably has a greater supply of the necessary raw materials than any other country. Almost all the developing agents of today can be made experimentally in any well-equipped laboratory, but their commercial manufacture is a question of the investment of very considerable capital.

Coal-tar Derivations

Most of the present developing agents are made from substances that are derived from coal-tar. Benzene, C_6H_6, is a volatile liquid that is derived from the distillation of tar. The transformation of this substance into developing agents is a complex chemical process. A common procedure is first to prepare phenol (car-

bolic acid), C_6H_5OH, and then treat this with nitric acid. This treatment gives nitrophenol. The latter substance is then treated with iron and acid, and put through a variety of other treatments before the final products are obtained. The manner of the chemical treatment that is used determines the composition, development energy, and the general nature of the developing agent that is produced. Pyrogallic acid and hydroquinone are quite closely related chemically to carbolic acid. The great majority of the developing agents sold are not sold under their true chemical name, but under some patented trade name by which they are more commonly known. In many cases different manufacturers or dealers sell the same developing agent but under a different trade name, e. g.: Metol, satrapol and rhodol are practically identical in their chemical composition.

The Action of the Developing Agent

All developing agents are reducing agents. This means that all of them are capable of being oxidized along with a simultaneous change of the exposed silver bromide to metallic silver. During this process the activity of the developing agent is destroyed since the latter is changed into other substances.

As a rule, developing agents are weakly acid substances, and they do not show developing power until some alkali or alkaline substance has been added. The addition of the alkali results in the formation of a salt, and the latter is the true developing agent proper.

Developer Constituents

The constituents of a developing solution may be classified as follows, and their action and purposes summarized:

1. *Water, as a solvent for the other substances used.*

2. *A developing agent or a mixture of such agents.*—These are weak acids and unite with the carbonate of the developing solution to form the true developing agent itself.

3. *An alkali or an alkaline salt which has two chief functions:*—To open up the pores of the gelatine emulsion and give more easy access to the developing solution, and to react with the developing agent as indicated above.

4. *A preservative.*—In order to preserve the developing activitity of the developing solution for any length of time it is necessary to prevent the too rapid oxidation of the developing agent. This is done by the addition of a sulphite or a similar substance which combines with the developing agent to some extent and preserves the latter and also controls the color of the negative by preventing too great an amount of staining of the film.

5. *A restrainer.*—To control the rate of the developing process it is often well to add a substance that will control, restrain, or modify the rate and the character of the developing action. The substances used for this purpose are potassium bromide, or citric acid, or citrates. The potassium bromide appears to act by decreasing the solubility of the exposed silver bromide of the plate emulsion. Old developer acts as a restrainer since it contains an extra amount of potassium bromide formed during the process of development. Citric acid is a very powerful restrainer.

The Rate of Development

The factors which influence the rate of development are as follows:

1. *The speed of the plate.*—In general, the faster the plate the slower its rate of development.

2. *Temperature.*—Temperature affects the rate of development in several ways. The rate of diffusion of the developing solution into the gelatine emulsion is faster as the temperature rises. Also, higher temperature is favorable to a more rapid chemical action of the developing agent itself. The density of the silver deposit increases rapidly at first, then the amount deposited in a given time tends toward a limit, and this limit seems to depend upon the exposure.

3. *The character of the developing agent.*—Some developing agents work more rapidly than others.

4. *The concentration of the developing agent.*—The more of the developing agent in a given volume of the solution the more rapid the rate of development.

5. *The amount of the restrainer present.*—The restrainer changes the solubility of the silver bromide and therefore affects the rate of development. It also controls the color of the deposit.

Types of Developing Agents

There are two main types of developing agents: (1) Rapid-working, detail-giving developing agents; (2) slow-working, density-giving developing agents. Metol is an excellent example of the former of these; hydroquinone is a good example of the second class. It is often desirable to combine the good qualities of these two classes, as is done in the well-known metol-hydroquinone developer, perhaps the most widely used developer of today.

Characteristics of Different Developers

It will be profitable to discuss the different developing agents in detail and to indicate the characteristics which distinguish them in action. These characteristics are the result of the chemical formation of the agents.

Adurol

Hauff's Adurol is Mono-chlor-hydroquinone, $C_6H_3Cl(OH)_2$. Schering's Adurol is Mono-brom-hydroquinone, $C_6H_3Br(OH)_2$. The actual difference is very slight.

Adurol is a developer intermediate in character between the short-factor developers such as pyro and hydroquinone, and the longer-factor developers such as metol, rodinal, and amidol. It was first introduced commercially in 1899. It has grown in favor and will be liked by those who have used hydroquinone but dislike the defects of the latter. It comes as a gray-white powder which is fairly stable in air. It is more soluble than hydroquinone and dissolves readily when combined with an alkaline solution. It seems to be rather more active when potassium carbonate is used as the accelerator than when sodium carbonate is used.

Solutions of adurol act much like those of hydroquinone, but they keep better and they give negatives which are somewhat softer. The solution may be used repeatedly. The rate of action of the developer is not so much affected by temperature as in the case of hydroquinone. Too great a rise in temperature tends to cause fog and loss of contrast. Potassium bromide has little restraining action.

Adurol is one of the best developers for giving warm tones on bromide prints directly by development. It

works well with metol and the combination gives results very much like those of metol-hydroquinone.

Formula A good formula is: Sodium sulphite, 8 ozs. (200 cc.); potassium carbonate, 6 ozs. (150 cc.); water, 20 ozs. (500 cc.); shake till dissolved and add Adurol, 1 oz. (50 grams).

For negatives and gaslight papers this should be diluted with three to five parts of water; for bromide prints with seven to ten parts of water.

Amidol (Nerol) This is known to chemists as Diaminophenol, $C_6H_3OH(NH_2)_2$. The use of amidol as a developer dates from 1892. It comes in the form of gray or white crystals, which keep well in the solid state but not in solution. As a result of this it is a common thing to make up the solution to contain all the other constituents and then to add the amidol just before use. Some operators complain that this developing agent has an injurious (poisonous) effect upon the skin.

Amidol develops rapidly and the details appear so early that there is a tendency to stop the development too soon. It has the advantages of giving good detail and of being readily soluble, and the disadvantage that it stains the fingers and at times may stain prints. Sulphite that is to be used for amidol developers should be pure and free from sulphate. Acetone may be used as a preservative but it acts as a restrainer. Amidol will develop without the addition of carbonate.

Development with amidol should be pretty complete, as there is loss of density in the process of fixing. Fixing in an acid hypo bath may cause fog.

Small amounts of potassium bromide act to produce a clearing effect and large amounts are needed to cause restraining action. On gaslight and bromide papers an amidol developer restrained by bromide gives olive-green tones. Without restraint the tones are blue-black. It is especially adapted to bromide papers, but it is not particularly good for other papers. It is a favorite developer for lantern-slides on account of its power of giving good detail. In earlier days amidol was almost exclusively used for these methods of printing, with complete success.

Formula The solution of amidol is simple to make up and is convenient in use. For plate development Abney's formula is good: Amidol, 5 grs. (5 grams); sodium sulphite, 40 grs. (40 grams); potassium bromide, 1 gr. (1 gram); water, 2 ozs. (1,000 cc.). This solution will keep for several days in a well-stoppered bottle.

Eikonogen This is the sodium salt of amido bnaphthol bmonosulphonic acid. $C_{10}H_5(OH)NH_2SO_3Na$, with crystal water, and was introduced as a developer in 1889. The fresh substance is a powder or yellowish white crystals, but these darken somewhat on exposure to the air. It is sparingly soluble in water but easily soluble in the presence of alkali. Potassium carbonate appears to be rather better than sodium carbonate as an alkali for use with eikonogen.

It is a developer that works well with any of the usual methods of development. It gives negatives of good detail and of pleasing softness, even when the development is forced. For this reason it is a valuable developer for snapshots, flashlights, and all cases that are likely to show great contrast in the lighting. It works well with hydroquinone and the combination of eikonogen with hydroquinone yields detail and density in a pleasing way.

Eikonogen should be valued for its powerful developing action and for its results in under-exposures. Its activity is greatly affected by change of temperature and in this way it resembles hydroquinone. Solutions of eikonogen gradually darken with use but they keep their developing power for a long time. Use hot water in making up an eikonogen solution.

To get softer negatives, cut down the amount of carbonate and omit the potassium bromide. Potassium bromide acts powerfully as a restrainer, and it must be used with caution.

Formula On some gaslight papers the use of eikonogen-hydroquinone gives a variety of sepia tone directly by development. For plates and films it is best to use eikonogen with hydroquinone. Seed's Formula is: *A.*—Water, 16 ozs.

(480 cc.); sodium sulphite (cryst.), 2 ozs. (60 grams); eikonogen, 120 grs. (8 grams); hydroquinone, 30 grs. (2 grams). *B.*—Water, 16 ozs. (480 cc.); potassium carbonate, 2 ozs. (60 grams). For use take 2 parts of *A*, 1 of *B*, and 1 of water. The addition of more water decreases density.

Glycin To the chemist this is para-oxy-phenylglycin, $C_6H_4OHNHCH_2COOH$. Commercially glycin comes in the form of flakes or crystals, not very soluble in water, but easily soluble in sodium-sulphite solutions and still more soluble in sodium-carbonate solutions. When glycin is kept carelessly it gradually darkens and loses its developing power. It has two characteristics that make it a very satisfactory and valuable developer; it develops very clearly and its action is under very easy control.

Glycin gives very clean negatives, and as a result of this power it is popular for black-and-white work, half-tones and reproduction processes in general. It is an excellent developer for use with collodion emulsions. Negatives developed with glycin are of sufficient density and they are transparent in the shadows without loss of detail. It is free from any tendency to stain the negative. The deposit of silver in the negative developed with glycin is of very fine grain, and for this reason this developer is excellent for use in microphotography.

In its manner of working, glycin is very much like ferrous oxalate. At present it is used almost entirely for tank development. Its action is considerably affected by temperature. It is sensitive to the restraining action of potassium bromide, and can be varied greatly to suit the conditions imposed by time of exposure, temperature, etc. As compared with hydroquinone it is a rather expensive developer.

Formula The following Agfa formula is good: *A.*—Distilled water, 32 ozs. (1,000 cc.); sodium sulphite (crystals), 1.7 ozs. (50 grams); glycin, 0.3 oz. (10 grams). *B.*—Distilled water, 16 ozs. (500 cc.); potassium carbonate, 3 ozs. (100 grams). *C.*—Distilled water, 3 ozs. (100 cc.); potassium bromide, 0.3 ozs. (10 grams). For correct

exposures take 4 parts of *A* and 1 of *B*. For over-exposures take 10 parts of *A*, 5 of *B*, and 1 of *C*.

Hydroquinone Sometimes called hydrochinone or quinol is para-dihydroxybenzene, $C_6H_4(OH)_2$ (1:4), and was first suggested as a developing agent by Sir William Abney in 1880. It occurs as white or pale brown needles. The latter darken somewhat in the light but do not decompose much.

In its chemical composition, hydroquinone is very closely related to pyrogallic acid and to carbolic acid. In its developing action it is also much like pyrogallic acid, but it gives more contrast and its action cannot be modified so readily. Used alone it gives great density and as a result is very useful for mixing with other developing agents, such as metol.

The rate of development with hydroquinone is affected more by changes in temperature than that of any other developer. Below 65° Fahr. it works very slowly, and at lower temperatures it does not work at all. It works more rapidly with sodium carbonate as the accelerator than with potassium carbonate, but the latter seems to give better gradation. The best results, especially in the development of lantern-slides, come from the use of potassium hydroxide as the accelerator. With slight over-exposure and slow development it gives brilliant negatives.

Hydroquinone works well with metol, eikonogen, or other developing agents. When used alone it is likely to give too much contrast. It is a relatively slow developer and it is very sensitive to the action of potassium bromide. It is a popular developer on account of its clean action and its ease of use. It gives black deposits and the solution may be used for some time without staining. In making up the working solution the sulphite should always be dissolved before the hydroquinone is added. Hydroquinone developers work well with bromide papers.

Formula The Lumière Brothers recommend the following formula: Water, 5 ozs. (1,000 cc.); sodium sulphite, 400 grs. (183 grams); hydroquinone, 40 grs. (18.3 grams);

formalin, 50 drops (20.0 cc.). In this formula no alkali or bromide is called for.

Metol

Similar preparations are sold under the names, satrapol, and rhodol, etc. Apparently there are on the market several preparations that are alike or so nearly the same chemically that they do about the same work as developing agents. According to Merck's Index, metol is mono-methyl-para-amido-metacresol sulphate, $C_6H_3OHCH_3(CH_3NH)_2H_2SO_4$.

Metol has other uses than in photography. In the past it has been used considerably as a dye for furs and feathers.

It is sold as a white, gray, or pinkish white powder or finely crystalline mass, easily soluble in water.

One of the chief advantages of metol is that its solution can be used repeatedly without danger of staining, if the metol is pure. A good test for its purity is to see whether it entirely dissolves in strong hydrochloric acid. Pure metol ought to dissolve completely in this reagent. It is often made from hydroquinone or from nitrophenol.

Metol is one of the most powerful of the modern developing agents. With normally exposed plates, it gives very soft negatives, and for this reason it is not generally used alone but is combined with some other developing agent, such as hydroquinone. Metol is used to get the detail and the other developing agent is used for density. Used alone metol is not a very good developer for plates, and such a solution is not suited to tank development.

Metol is poisonous to some persons. In such cases the operator should either wear rubber gloves or discard its use in favor of some other developer. Prevention is better than cure.

With a metol developer the plates and films should be well developed as there is some tendency to lose density in the fixing-bath. The rapid appearance of the image and the slower growth of density lead many operators to stop development too soon.

For the production of detail metol is good in cases of short exposures, or when harshness is to be avoided. A

well-restrained or old developer tends to give the more parallel development of detail and density at the same time. In using a metol-hydroquinone developer in cold weather it is well to use more than the usual proportion of metol as compared with the hydroquinone.

To gain a better control of the development process, the metol may be dissolved in the sulphite solution (as with pyro). In such a case the development is controlled by adding the solution of carbonate or the solution of potassium bromide as occasion demands. By restraining with 10 per cent solution of potassium bromide or a 10 per cent solution of hypo it is possible to allow time for the developing solution to diffuse into the plate emulsion so that depth and surface development proceed more nearly at the same rate. Density and detail go together. Citric acid is a good restrainer and gives more contrast in the plate.

Metol-Hydroquinone This is the most common combination of metol with any other developing agent, though pyro-metol is very good. Metol-hydroquinone acts much like pyro-metol, and gives negatives of a more actinic quality. As a result the process of development should be pushed farther. Metol-hydroquinone is by many considered to be the best developer for bromide and gaslight papers, and has general all-round good qualities. In cold solutions more of the development is done by the metol than is true of warmer solutions. In making up solutions of metol and hydroquinone always dissolve the substances in the following order,—metol, sodium sulphite, and hydroquinone.

Formulas Many formulas have been recommended for these developing agents, but the following are good ones: (Hauff Formula.) *A.*—Metol, 130 grs. (15 grams); sodium sulphite, 3.5 ozs. (175 grams); water, 20 ozs. (1,000 cc.). *B.*—Sodium carbonate, 3.5 ozs. (173 grams); potassium bromide, 14 grs. (1.6 grams); water 20 ozs. (1,000 cc.).

The following formula gives a very good print-developer: Water, 15 ozs. (450 cc.); metol, 18 grs. (1.2 grams); sodium sulphite, dry, 0.3 ozs. (9.0 grams);

hydroquinone, 18 grs. (1.2 grams); sodium carbonate, dry, 0.15 ozs. (4.5 grams).

As restrainer use a 10 per cent solution of potassium bromide as desired.

Metol Substitutes

Many of the new developing agents that are being used in place of metol are derivatives of para-amido-phenol, $C_6H_4OHNH_2$.

These substitutes will not have the same properties as the para-amido-phenol itself, but they are more or less related to it and their action will be similar, varying according to their composition. Para-amido-phenol resembles rodinal and amidol in its action. Its solutions keep well for a considerable time and give good results without the addition of large amounts of carbonates or other alkalies. The tone of the image on a print will depend to some extent upon the concentration of the solution and will also be affected by the amount of bromide used.

It seems probable also that several of the new makes of developing agents that are being put on the market are merely some of the older forms being sold under new names. Other substitutes are plainly mixtures of metol and hydroquinone with the latter agent largely in excess, and others again are merely adulterated metol, uncertain in action and efficiency. In buying metol substitutes in the present market the wise reader will place his reliance chiefly on the reputation of the firm or maker behind the substitute offered.

Ortol

This substance is a mixture of two molecular weights of methyl-ortho-amido-phenol, $C_6H_4OHNHCH_3$, with one molecular weight of hydroquinone, $C_6H_4(OH)_2$. It comes as a yellowish white powder, and was introduced from Germany in 1897. It is rather unstable in the light, so it is better to keep it in a rather dark place or in a dark yellow bottle. Ortol is used considerably to replace metol, especially for those operators to whom metol is poisonous. It does the work about as well as metol but the color of the deposit is slightly different.

In its action, ortol is intermediate between metol and pyro. It gives negatives very much like those made

by pyro, but the image is more actinic and the developing process need not be carried quite so far as with the pyro developer. Ortol gives good gradations and plenty of density. A solution of ortol may be used repeatedly as its activity lasts better than that of most of the common developing agents. Without the use of sulphite in the solution the ortol solution keeps only for one day. A decrease in the amount of sulphite gives negatives of greater density and browner color. A more dilute solution of ortol gives slower and softer results in development. A 10 per cent solution of potassium bromide restrains the action of ortol greatly, and a 10 per cent solution of caustic soda or caustic potash accelerates its action very greatly.

Ortol does not ordinarily stain the negative, but when it contains ammonia or acetone it sometimes gives a reddish stain. Carbonate or potassium metabisulphite in the solution appear to prevent stains. Stains on the plate may be removed by the use of methyl alcohol. Ortol works well for plates, lantern-slides, or prints. It combines well with hydroquinone, and in most metol-hydroquinone formulas the metol may be replaced by an equal quantity of ortol.

Formula

Ortol is used to some extent for tank-development. A good formula for this purpose follows: Ortol, 10 grs. (0.7 gram); potassium metabisulphite, 5 grs. (0.3 gram); sodium sulphite, 65 grs. (5.0 grams); sodium carbonate, 65 grs. (5.0 grams); water, 20 ozs. (600 cc.).

Pyro

Pyrogallic Acid (Pyrogallol). Chemically trihydroxybenzene. $C_6H_3(OH)_3$ (1 : 2 : 3). Pyro is one of the oldest developers; it was introduced by Scott Archer in 1851. At first it was a very expensive substance but it is now quite cheap. The pyro of commerce is made from gallic acid by heating it. Commercially it comes in the form of light, white crystals. These are so light that they often float around and settle where their presence is injurious. Recently a more compact (crystal) form of pyro has been put under various trade names.

Pyro has the property of absorbing oxygen from the air with ease and darkening readily. It has been used as

a hair-dye. The darkening and oxidation of pyro occur very much more readily in an alkaline solution than under other conditions. On account of this very easy oxidation and the darkening it is essential to use an efficient preservative in all pyro solutions. For this purpose sodium sulphite is not so efficient as it is with other developing agents. Stock solutions of pyro keep well if they are acidified with citric acid, oxalic acid, or sulphurous acid. Potassium metabisulphite ($K_2S_2O_5$) seems to be one of the best preservatives. When needed for use portions of this acidified solution are mixed with the proper amounts of the solution of accelerator.

As an accelerator, ammonia was formerly used with pyro solutions, but this has been largely replaced by sodium carbonate, or potassium carbonate. On account of the easy oxidation of pyro it is best to dissolve the carbonate and sulphite first and then add the pyro (dry) just before development begins. With sodium carbonate, under usual conditions, the growth of density and detail go along well together and the gradations produced are pleasing. Some operators prefer to use acetone as accelerator in place of the usual carbonate. The use of potassium carbonate as the accelerator seems to give greater penetration of the developing solution into the emulsion, or more depth development.

The great advantages of a pyro developer are that it is cheap, its action is easy to control, and its solution may be adjusted to the most variable conditions. The negatives produced with pyro are stained slightly and produce more contrasts on prints than their visual density would indicate.

The disadvantages of pyro are the staining of hands, plates, etc., and the difficulty of keeping the solution for any great length of time. On the other hand, the solution is cheap and easy to make up and the results obtained are good. For negatives that are to be used with printing-out papers, pyro is probably the best of all developing agents. Many prefer it to all others for portrait work. The stain on pyro-developed plates may be reduced in amount by use of fresh solutions with plenty of preservative or an excess of sodium sulphite, or the

stain may be removed from the negative by treatment with a solution of alum and sulphuric acid.

Pyro works well when used with metol. The resulting developer is very sensitive to the action of potassium bromide as a restrainer.

Formula The use of three-solution formulas for pyro development of plates that may have had varying exposures is a good plan. The three-solution formula recommended by the G. Cramer Plate Company is excellent. A standard formula for the use of dry pyro follows: Pyro, 30 grs. (9 grams); sodium sulphite, 240 grs. (55 grams); sodium carbonate, 240 grs. (55 grams); water, 10 ozs. (1,000 cc.).

To make up this formula dissolve the sulphite and carbonate separately in 5 ozs. of water. For use, take an equal quantity of each solution and, just before use, add 3 grs. of dry pyro to each ounce of solution.

Rodinal (Citol) This is a one-solution developer and its composition is simple. It is a solution of para-amido-phenol $C_6H_4(NH_2)OH$. It is a very convenient developer, since the solution as sold requires simply to be diluted with 10 to 40 parts of water for use. The amount of dilution varies with the exposure and the kind of plate used or the sort of negative desired. Since rodinal contains little carbonate in the commercial solution, there is little need of using distilled water for the diluting. Hard waters will give slight precipitation. The manufacturers state that Agfa rodinal contains: Water, a neutral sulphite, and an alkaline salt of para-amido-phenol, but no caustic alkali. The solution keeps well in a stoppered bottle. In air the solution gradually darkens but this does not interfere much with its developing power. The diluted solution does not keep so well as the concentrated solution. The addition to it of a small amount of sulphite preserves it better.

Rodinal gives good detail, but there is sometimes not quite sufficient density. When diluted with 10 to 20 parts of water, it gives quick development and strong contrasts. When diluted with 30 to 40 parts of water, it gives slower development and less contrast. It works

well on bromide papers. On such papers the tones may be varied greatly by changing the dilution. The weaker the solution, the grayer the tones.

The manner of using rodinal is more convenient than that of most other developing agents. It gives good negatives that are clear, clean, and have good gradation in lights and shadows. The best temperature is about 60° Fahr. Development should be rather full, as there is some loss of density in fixing. Rodinal works well for lantern-slides. For portrait work it is best to combine rodinal with hydroquinone. Its developing action may be restrained by use of bromide if so desired. For tank-development it is generally diluted with 100 to 200 parts of water. In cases of over-exposure use less water and add a little bromide.

Fixing Solutions

In the early days of photography many things were tried as fixing-agents. Common salt was one of these substances. Later on potassium cyanide was used, but it was objectionable on account of its poisonous properties. Ever since the salt sodium thiosulphate (hypo) was discovered it has taken the place of all other substances as a fixing-agent, on account of its effectiveness, cheapness, and the fact that it dissolves easily and does not injure the silver image.

Chemical Action of Hypo

The hypo bath must be of the proper concentration for the most efficient action and thorough fixation, and a bath that is either too weak or too strong will not do the work to the best advantage. It is essential that the products formed by the process of fixation shall be easily soluble and easily removed from the negative by the washing which follows the fixing process.

If the solution of hypo is too weak the following chemical change occurs: $AgBr + Na_2S_2O_3 = NaAgS_2O_3 + NaBr$. In this case the silver bromide reacts to form the rather insoluble salt, $NaAgS_2O_3$, *and the easily soluble sodium bromide*, NaBr. Later on the insoluble silver sodium thiosulphate which remains on the plate is likely to discolor and injure the image.

If a more concentrated solution of the hypo is used, then there is no tendency to form this insoluble salt but

a highly soluble double thiosulphate of sodium and silver is formed instead. The reaction is, $2AgBr + 3Na_2S_2O_2 = Na_4Ag_2(S_2O_3)_3 + 2NaBr$. In this case both of the products formed are easily soluble in the water used for the washing of the plate and as a result a permanent negative is produced. Silver iodide plates are more difficult of fixation than silver bromide plates because the silver iodide is rather insoluble in hypo solutions.

The double thiosulphate of sodium and silver formed in the process of fixation is quite sweet to the taste, and it is a common trick to judge the age of the fixing-bath by the taste. The older the fixing-bath the sweeter it becomes.

The fixing-bath will attack the silver of the image on the negative after a time, so it is not well to leave the plate in the hypo solution much longer than is necessary for thorough fixation.

Acid Hypo and Hardening Baths

The ordinary plain hypo fixing-bath works well, but when the temperature is too high there is a tendency to soften the gelatine of the emulsion and detach it from the plate. This is especially true if soft gelatine has been used in the manufacture of the plate.

As a result of this effect it is the common custom to use a hardening bath to harden the surface of the gelatine and render the negative more resistant against warm solutions. Various things may be used effectively as hardening agents. Formaldehyde solutions, solutions of alum, sodium acetate, alum with acetic acid, etc., are capable of hardening the gelatine considerably. For this purpose chrome alum is slightly more efficient then common potash alum.

Such hardening baths may be used on the plate after development and previous to the fixing, but it has become the custom on account of the convenience of the procedure to combine the process of hardening with the process of fixation. The solution used for this purpose constitutes the combined hardening- and fixing-bath. Such a solution has the advantages of combining the two operations and saving time, but it has certain disadvantages which we will now consider.

The hardening of the gelatine emulsion renders it more difficult to carry out any methods of intensification or reduction of the silver deposit on the negative. Besides this there is a marked tendency for the decomposition of the hypo in the combined fixing- and hardening-bath, and as a result of this there is the possibility of staining of the negative. Another thing, the acid fixing-bath remains clear for a long time and there is danger of using it much longer than it has effective fixing power. By proper mixing of a combined fixing- and hardening-bath there is little danger of decomposition of the hypo but it is always a possibility. Alum in solution gives a certain acidity of itself and the latter tends to decompose the hypo with the formation of the same products as are formed in the hypo-alum toning-bath.

In hot weather the use of a freshly prepared solution of acid fixing-bath is a good thing; but for the remainder of the year plain hypo baths may be used just as efficiently and some of them when carefully made up and properly used are cheaper and more convenient.

In making up an acid hypo fixing- and hardening-bath it is very necessary to mix the chemicals in the order given and just as directed. An acid hypo bath will often remove a slight stain due to developer.

A Rapid Fixing-Bath

Some time ago it was found that the salt, ammonium thiosulphate, $(NH_4)_2S_2O_3$, which corresponds to sodium thiosulphate (hypo) is a much more active fixing-agent than hypo itself. This salt does not keep well in the solid state, but is easily formed in solution by simply mixing together solutions of hypo and ammonium chloride (sal ammoniac). The chemical change is as follows: $Na_2S_2O_3 + 2NH_4Cl = 2NaCl + (NH_4)_2S_2O_3$. The products of the reaction are the ammonium thiosulphate and common salt, NaCl. The latter is harmless in the solution and of itself has a slight fixing action. During the mixing of the solution the temperature falls considerably but when it rises again the rate of fixation of the solution is remarkable.

Experiments by the Lumière Brothers prove that this fixing-bath is very efficient for two reasons. The

process of fixation is extremely rapid and thorough, and the products of the fixing process are so soluble that only a very short time of washing of the negative is required. The time of fixing is about one-fourth that required in the ordinary hypo bath, and the time of washing of the negative can be cut down to five or ten minutes. The writer has repeatedly fixed plates in two minutes.

Formula

Of course the solution contains no hardener, and so it is best to keep this fixing-bath cool during its use. Its cheapness and the convenience of making up the solution render it very desirable. Hypo, 8 ozs. (250 grams); sal ammoniac, 3.5 ozs. (100 grams); water, 32 ozs. (1,000 cc.).

For use on prints the solution may be made up somewhat weaker. After use on prints it is best to throw away the solution or to add more hypo and use it for fixing plates and films.

Reduction

The usual causes of too great density in negatives are either over-exposure or over-development, or both.

Remedies: The process of reduction will not make a perfect negative from an over-exposed plate but it will improve matters considerably. The methods of reduction of the silver deposit are either physical (mechanical) or chemical. The latter kind of method is the more common, and it has wider application. A great variety of chemicals may be used for the process of reducing the density of the deposit of silver on the negative.

Physical Methods

Under this heading we may consider the use of any abrasive substances that will act to grind or wear off a portion of the silver and so decrease the density of the image. This procedure of grinding down the silver deposit is generally applied for local reduction when only a portion of the negative is to be treated. For a general reduction of the deposit all over the plate one of the several chemical methods is better.

The substances used for the mechanical grinding off of silver should be very finely divided. Powdered chalk works well when rubbed on to the negative by the

finger followed by washing and drying of the plate. Many of the common kinds of fine-grained metal polishes work well for this purpose. The writer has had good success with the metal polish sold under the name of "Putz Pomade."

Chemicals Methods

For the chemical method of reduction of the silver deposit we may use any chemical reagent that will dissolve off silver by chemical means without destroying the gelatine or staining the negative. In general the chemicals that are available for this purpose include substances that are powerful oxidizing agents. Reduction of the deposit of silver on the negative is a process of chemical oxidation of the silver to form compounds that are soluble in the solution used. By a proper choice of the oxidizing agents used it is possible to reduce the density of the deposit and to change the contrast.

Preparation

All methods of reduction of the silver deposit are rendered more difficult if the plate has been previously fixed in an acid hypo fixing-bath than if the plain hypo bath was used. Anything that hardens the gelatine renders the process more difficult. Differences in the rate of diffusion of the solutions used for the reduction determine the character of the process. In ordinary cases more of the silver deposit is near the surface of the gelatine layer since the developer acts first on the surface of the plate emulsion. As a result of the above considerations the chemical reducing methods for negatives may be grouped into surface reducers and depth reducers (progressive acting). These may be chosen for particular purposes and results.

Most of the chemicals used in the processes of reduction keep well in the solid state, but they so not keep very long when in solution. Many of them decompose readily after mixing and often they are affected by light. For these reasons it is best to use fairly fresh solutions at all times. If possible it is best also to use distilled water in preparing the solutions. The process of reduction is one that should be done carefully as it is quite easy to over-do it and reduce the density of the negative too much.

If the plate is dry at the start it is well to soak it in water for a short interval before the reduction process is begun, and it is always necessary to wash out all hypo from the plate unless hypo is a constituent of the solution that is to be used.

The chemicals that are used for the reduction of density may be further divided into those which transform the silver into a compound that is soluble in water, and those which form an insoluble compound of silver which is not soluble in water, but which is soluble in a solution containing other chemicals, added for the purpose.

There are many solutions that may be used for carrying out the process of reduction of negatives, but only a few of the best and most commonly used ones will be described below. By proper use of these few it will be possible to do all reduction procedures that are necessary in daily work.

The Farmer Reducer

This is potassium ferricyanide *plus* hypo, and is named for the man who first suggested its use. As commonly made up it consists of a solution of potassium ferricyanide with the addition of hypo or certain other chemicals. The addition of other chemicals is for the purpose of preventing the decomposition of the ferricyanide, but for other reasons their presence is objectionable. The process may be carried out as a two-solution method by first treating the plate with the solution of potassium ferricyanide and then treating it with the solution of hypo, but this process is slow. It is more common to make up the mixed solution of ferricyanide and hypo just before use. The chemical action of the mixed solution depends upon the formation of a ferricyanide of silver and the latter is soluble in the solution of hypo. $2Ag + 2K_3Fe(CN)_6 = K_4Fe(CN)_6 + K_2Ag_2Fe(CN)_6$. The silver of the image is attacked by the ferricyanide with the formation of potassium ferrocyanide and a ferrocyanide of silver and potassium, and the latter dissolves in the hypo present. Some authorities hold that the salt, $Ag_4Fe(CN)_6$, is formed.

The rate of action of the Farmer reducer is proportional to the amount of ferricyanide used, but the rate

is not proportional to the time of action on account of the decomposition of the potassium ferricyanide by the action of light. Too much hypo or too little of it will cause decreased rate of action. Too much hypo causes the solution to decompose and lose its activity.

Formula

The following formula is a good one, viz: Equal parts of a 5 per cent solution of potassium ferricyanide and a 10 per cent solution of hypo.

The Farmer reducer acts rather more readily on the weaker tones and it may destroy details in the shadows. It is valuable for use on over-exposed, foggy, or veiled negatives, since it tends to increase the contrast and reduce the density. By soaking the plate in hypo solution previous to reduction or by treatment with alcohol there is less tendency to destroy the detail of the shadows. A short time of action is good for fogged negatives.

It works equally well for plates, films, and lantern-slides. After the process of reduction it is well to put the negative in an acid hypo fixing-bath for a short time, then wash well and dry in the usual way. The convenience of the Farmer reducer is that the negative need not be washed free from hypo before the reduction is carried out; the inconvenience is the rapid decomposition of the solution that is used for the process.

Persulphate Reducer

The persulphates of potassium and sodium and ammonium are now common commercial products. They are powerful oxidizing agents and they seem to be unusually active in the presence of silver. These substances have the chemical formulas, $K_2S_2O_8$, $Na_2S_2O_8$, and $(NH_4)_2S_2O_8$.

Persulphates are very good for reducers as they have the power of acting rapidly and of keeping well in the dry state and fairly well when in solution. If the solution is made up by the use of distilled water it has very good keeping qualities. A solution of a persulphate diffuses into the gelatine emulsion more rapidly than a solution of ferricyanide, and so the persulphate reducer acts through a deeper layer of the gelatine film. In the shadow portions of a negative there seems to be a different form or kind of silver grains than there is in

the other parts, and when the plate is treated with a persulphate reducer there is a difference in the action on the high-lights and the shadows.

The chemical action of ammonium persulphate reducer is, $2Ag + (NH_4)_2S_2O_8 = (NH_4)_2SO_4 + Ag_2SO_4$. The products formed are ammonium sulphate and silver sulphate, and both of these salts are soluble in water. The first action of the persulphate seems to be that given in the chemical equation, and then an oxidation of the emulsion with removal of more silver follows. A solution that contains more than about 5 per cent of the persulphate is very likely to attack the gelatine emulsion badly.

The action of the persulphate is so rapid and vigorous that it is well to put the plate in a solution of sodium sulphite containing a few drops of sulphuric acid in order to stop the reduction of the silver deposit. This reducer appears to decrease the size of the grains of silver all through the emulsion. Impurities in ordinary water have a great effect upon the activity of the persulphate reducer, and common salt is very active in this respect. On account of this property it is always best to use distilled water for making up the solution. It has been suggested that an easy way to control the action of this reducer is to add a trace of common salt when the action becomes too rapid. The persulphate reducer does not attack the fog on a plate so much as in the case of the Farmer reducer.

The character of the reduction by the use of the persulphate reducer varies somewhat with the degree of reduction. As ordinarily used, only the dense parts of the silver image are attacked, but if the action is allowed to continue, the lighter deposits of silver will be dissolved. The usefulness of the persulphate reducer is this selective action and its ability to harmonize the harsh contrasts that sometimes occur on negatives. With a moderate amount of reduction the solution acts to decrease the contrast.

Formulas

For use as a progressive reducer take: Ammonium persulphate, 1 part by weight; water (distilled), 100 parts by weight. For use as a reducer to change contrasts take:

Ammonium persulphate, 2 parts by weight; distilled water, 100 parts; common salt, 1½ to 2 parts.

During its action the solution will become milky in appearance and this is a sign of its working properly. To stop the action use a weak solution of sodium sulphite, or an acid fixing-bath. The latter is preferable to avoid danger of staining. Finally wash the negative thoroughly and dry it as usual.

There is not much choice between ammonium and potassium persulphate or the corresponding sodium salt. All of them act in the same way. Persulphate solutions should be kept cool.

Permanganate Reducer

The beautiful purple salt known as potassium permanganate is a powerful oxidizing agent. It is on this account that the salt is a good disinfectant, and remover of hypo from prints. Permanganate acts best in a solution that contains a little sulphuric acid. The acid prevents the tendency to deposit any brown stain of manganese dioxide on the plate.

Formula

Solution *A*.—Potassium permanganate, 70 grs. (4.5 grams); distilled water, 30 ozs. (1,000 cc.). Solution *B*.—Sulphuric acid (strong), 0.6 ozs. (21 cc.); distilled water, 30 ozs. (1,000 cc.). Pour the acid into the water slowly with stirring.

For use take 10 parts of *A*, 10 parts of *B*, and 60 parts of pure water. After the reduction process wash the plate well and dry as usual. Previous to the washing it is a good plan to put the plate in an acid hypo bath for a short time. For convenience and ease of working, this reduction method is very good. The solutions keep well if they are made up from pure chemicals and kept in the dark. The reducing action on the negative is quite uniform, but with a tendency to attack the dense portions of the negative rather more than the thin parts.

Intensification

The usual causes of thinness in negatives are under-exposure and under-development.

Remedies: Some method of increasing the density or the opacity of the deposit on the negative. It is more difficult to increase the density of the deposit of silver

than to decrease it, but it is possible to improve a negative of this type.

The usual procedure for the process of intensification is first to put the negative through a bleaching process. This bleaching process is carried out by the action of a solution of mercuric chloride on the negative. Mercuric chloride is more commonly known as corrosive sublimate, so it will be realized that the solutions used on the plate in this process are very poisonous. They should be carefully labelled and cuts in the skin of the operator should be protected against absorption of the poisonous solution.

The solution of the mercuric salt, together with potassium bromide (or some similar substance), acts upon the silver of the negative to change it to the gray silver chloride, or silver bromide. At the same time there is formed on the negative a certain amount of mercurous chloride (calomel).

If the bleaching solution is too strong it will attack the gelatine and will cause unevenness of the bleaching effect, and a mottled appearance on the plate. The addition of a little hydrogen peroxide to the bleaching solution causes a more rapid action. The solution of the mercuric salt used for the bleaching may be used repeatedly if care is taken to throw away the sediment which gradually collects in it.

All of the operations of intensification, like those of the reduction methods, may be carried out in daylight. The chemical action of the mercuric chloride is as follows: $2Ag + 2HgCl_2 = 2AgCl + 2HgCl$. *In a like way for mercuric bromide* ($HgBr_2$),*—we have,* $2Ag + 2HgBr_2 = 2AgBr + 2HgBr$.

After the bleaching process it is necessary to wash the plate very thoroughly to remove all the soluble mercury salt. In order to hasten this process it is well to add a little nitric acid to the water that is used for the washing of the plate. The bleaching action and the washing should be thoroughly done. There is no danger of too much bleaching. In all these operations never use the same trays as are used for developing and fixing, or bad strains will result.

After the bleaching and thorough washing of the

plate the next process is the darkening of the bleached negative. This darkening process may be done by a variety of chemical treatments, and the degree of intensification and the permanence of the result will be determined by the darkening agent used.

The Bleaching Solution

Mercuric chloride (corrosive sublimate), 6 grs. (25 grams); hydrochloric acid (concentrated), 2 ozs. (5 cc.); water, 30 ozs. (1,000 cc.). This is best made up with distilled water.

Blackening the Negative

Darkening by the use of ammonium hydroxide (ammonia solution). When this darkening agent is used it has the power to change the silver chloride (formed in the bleaching) to a complex silver salt, to change the mercurour chloride (calomel) to a white substance, and also to deposit finely divided particles of a gray metallic mercury. The chemical changes are $2HgCl+2NH_4OH = NH_2HgCl+NH_4Cl+Hg(gray)+H_2O$ and $AgCl+2HgCl+3NH_3=NHAgHgCl+2NH_4Cl$. Metallic mercury is opaque and so it increases the density of the silver deposit on the negative. The other products that are formed in these chemical changes are either harmless or else they are soluble in water and are easily removed by the washing process which follows. The metallic mercury formed on the plate slowly vaporizes on standing and so this method of intensification is not quite so permanent as some others, although the method is simple and easy to use. For ordinary work this method of darkening the bleached negative is perhaps the best one to use and most easily controlled.

Re-development

This method of darkening of the bleached image works well, and is preferred by many operators. The most common developers used for this purpose are amidol and ferrous oxalate. Chapman Jones, in England, has studied this matter carefully and he has concluded that ferrous oxalate is preferable to ortol, pyrocatechin, or darkening by the use of sodium sulphite, etc.

The development by ferrous oxalate gives a deposit on the plate of a mixture of metallic silver and metallic mercury. The other products of the development are

ferric oxalate and potassium chloride. These are easily soluble in the wash-water used. An ordinary amidol developing solution is equally effective.

Use of Sulphide

If the bleached image is treated with a solution containing ammonium sulphide, sodium sulphide, or potassium sulphide, then the silver and mercury chlorides on the bleached negative are changed to the sulphides of the metals mentioned.

The change may be shown by the following equation: $2AgCl + 4HgCl + 3(NH_4)_2S = Ag_2S + 2Hg_2S + 6NH_4Cl$. Since the sulphides of mercury and silver are not volatile, or do not vaporize on standing, this method gives very permanent results. These products are very opaque substances and they afford a good printing quality. The disadvantage of this method is the danger of action of the fumes of the sodium sulphide solution upon photographic papers, plates, etc., kept in the room. If they are well protected and kept at a distance no harm will result, but it is well to work outdoors or at an open window. A very weak solution of the sulphide is used for the darkening process. Only enough of it is added to the water to give the appearance of a faint yellow color. After the darkening the plate is washed and dried as usual.

The Chromium Intensifier

By treating a negative with a solution of potassium dichromate and acid the image is bleached by conversion of the silver to silver chloride. By re-development of the bleached image an intensification results. The following solutions are used: Solution *A*.—Potassium dichromate, 0.25 oz. (5.5 grams); water, 3.5 ozs. (100 cc.). Solution *B*.—Hydrochloric acid (conc.), 0.2 oz. (6 cc.); water, 3.5 ozs. (100 cc.).

These two solutions keep well separately but not when mixed. For use, take 1 part of *A*, 1 part of *B*, and 2 parts of water. First soak the plate well in water, bleach it in the mixed solution as directed, and then wash it until all yellow color has disappeared from the wash-water. Expose the plate to daylight or sunlight for a short time and then re-develop with an amidol or metol-hydroquinone developer. The time of printing

is increased about 50 per cent. The process may be repeated if desired.

If a negative is to be used for the printing of platinum prints none of the mercury intensification methods should be used. Use the chromium intensifier instead.

Making up Solutions

In dissolving a chemical substance in water in a bottle it is not best to put the substance in the bottle first and then add the water, as there is a tendency to form a cake of the substance and this hinders the process of solution. A better way is to put in part of the required water and add the substance gradually with shaking and finally dilute up to the required volume. Another good way is to put the substance in a piece of cheesecloth and hang the latter in the top of the bottle or earthern jar in which the solution is to be made up.

In the case of developing solutions it is also well to have the bottle nearly full of liquid when the solution is finally made up, so that there shall be very little air in the bottle to cause oxidation and deterioration of the solution.

Concentration of the solution.—In making up solutions of substances which tend to oxidize and deteriorate on standing, it is well to remember that a more concentrated solution keeps better.

Density of the Solution.—Often photographic formulas call for solutions to be made up to a certain number of degrees Baumé. The Baumé scale is an arbitrary way of stating how much heavier the solution is than water, by measuring it in degrees. A Baumé hydrometer will give the reading directly. A more common way of stating the density of the solution is in terms of the specific gravity. Water is assumed to have unit density or a specific gravity of one. A hydrometer will read off the specific gravity directly.

Printing Processes

Aside from the common methods of printing with papers coated with salts of silver, followed by the process of development by metol or other developing agents, there is a varied range of methods of producing images from negatives. Some of these give results as good as, or even better than, those by the ordinary methods in use.

The Kallitype Process.—This process dates from 1899, and the working of it depends upon the fact that a ferric salt is changed to a ferrous salt by the action of light. In this respect the process resembles the blue-print process, but the image on the finished print is entirely different.

For the Kallitype Process, paper is coated with a mixture of ferric salt and silver nitrate and dried. After exposure the paper is treated with a solution that acts as a solvent for the chemicals present, and the ferrous salt reduces the silver salt to silver. By proper treatment, this process gives excellent results, and it is a cheap and easy matter to prepare the paper when needed.

The Platinum Process.—This process gives the most permanent images and some of the most pleasing effects of any printing process known. The high cost of platinum makes it an expensive process.

The paper is coated with a mixture of ferric oxalate and potassium chlorplatinite and dried. On exposure the image partially prints out and is then developed to full intensity. During exposure the light changes the ferric oxalate to ferrous oxalate. During development a solution of potassium oxalate dissolves the ferrous oxalate and the latter develops the print by the deposit of finely divided metallic platinum. The image is very permanent on account of the extreme chemical stability of platinum against all chemical agents. Washing with dilute hydrochloric acid and drying complete the operations of this process.

The Carbon Process.—The carbon, gumbichromate, and other processes closely related to them depend upon the chemical properties of a mixture of gelatine and potassium (or ammonium) bichromate when the mixture is exposed to light. Where the light acts most strongly the gelatine is rendered insoluble in warm water. Therefore after the exposure to light the printed paper is treated with warm water and the unexposed parts may be dissolved away. If the mixture (bichromated gelatine or gum) has been previously colored by pigments, then on washing, the color of the paper background shows through, and in this way an image is

formed on the paper. Considerable care and skill are required in the preparation, printing, and development of the papers used in this process, but the results are good. It is possible to use a great variety of pigments so that the color of the prints produced may be varied almost at will.

The Blue-Print Process.—In this process the paper is coated with a mixture of a ferric salt and potassium ferricyanide and then dried.

Exposure during printing changes the ferric salt to a ferrous salt. When water is added for the process of development, the ferricyanide and the ferrous salt dissolve and react to produce an insoluble substance known as Turnbull's Blue. The latter substance is of an intense blue color and quite permanent. The fixing process consists in washing out the unchanged ferric salts and the excess of potassium ferricyanide from the print with water. By a knowledge of the chemical changes involved, it is possible to tone blue-prints in various colors. The advantages of the process are its cheapness, speed, and simplicity.

Storing and Handling Chemicals and Materials

It is not a common thing to hear much about the need of any particular precautions in regard to the storage of plates, films, or photographic papers, but there are some things that ought to be taken into consideration.

Of course it is evident that such materials should be protected against light, and it is also best not to let strong light fall on sealed boxes of plates. In some cases it will affect the materials inside. Protection against dampness is another important thing, especially where atmospheric conditions are changeable.

Photographic plates are quite sensitive to pressure also, and for this reason all boxes of plates should be stood on edge so that no pressure or weight comes on the sensitive surface of the plate. If exposed plates are to be kept for a time before development they should be stored in empty plate-boxes and put in so that no two emulsion surfaces come in contact with each other. If the emulsion sides are in contact the latent image may transfer from one plate to the other. Plates and papers

should be carefully protected from fumes of illuminating gas, toning-baths, and smoke of all kinds.

Water.—Many of the troubles of the photographer are due to impurities in the water he uses. Iron in water is particularly likely to cause trouble, and lime and other constituents of hard waters render it difficult to obtain duplicate results in tones on prints. The use of distilled water does away with all such difficulties. A small still for the distillation of water is not expensive to buy or to operate and the photographer will do well to buy one for the distillation of water to be used for making up solutions of developers.

Developing Agents.—These should be kept in stoppered bottles and in a rather dark place. Ortol, pyro, and some other developers darken in the light and their quality is somewhat impaired. There are two grades of pyro available, the light and the heavy crystals. The latter are more convenient in use, as they do not float around in the air so readily with the danger of contaminating other materials.

Salts used in Photography.—The commonest salts used by the photographer are: Sodium carbonate, potassium carbonate, sodium sulphite, potassium metabisulphite and hypo.

Many chemicals form crystals without having any water combined as a constituent part of the crystal. Other salts never form crystals without water in the combined state in the crystal. Still we have many salts which may occur in the condition of the "dry," anhydrous condition (not containing water), or in the crystal form and containing water. Many of these substances in the crystal form tend to lose water on standing in the air and at the same time give up the contained water. Usually it makes no difference which form of the substance we take for use provided we know how much of it to take. Of course, the crystal form of the substance does not contain so much of the active chemical agent by weight as the dry (anhydrous) form. One pound of the dry sodium carbonate is equivalent to a little over two pounds of the crystals. Potassium carbonate has two crystal forms and one dry. One pound of dry sodium sulphite is equivalent to two pounds of

the crystal sodium sulphite. Potassium metabisulphite comes in the dry form. It is an excellent preservative of developers. Two pounds of dry hypo are equivalent to about three pounds of crystal hypo. Potassium bromide comes only in the dry condition.

Sulphuric Acid.—This acid is not particularly poisonous, but it is very corrosive and easily destroys clothing, etc. Whenever water and acid are to be mixed, always pour the sulphuric acid into the water (or the solution) and during the pouring keep the mixture well stirred. Much heat is evolved in the process of mixing and with large quantities of the acid there is some danger of breaking containers by the heat.

Mercuric Chloride (Corrosive Sublimate).—This substance comes in shiny white crystals which are not very easily soluble. The salt should be kept out of sunlight and the bottle should be plainly marked "Poison."

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Department of Chemistry, University of North Dakota.

Notes and Comment

The proposed Memorial to Dr. Ferdinand Hurter and Mr. Vero Driffield, mentioned on page 184 of our last issue, should not be overlooked by American photographers. The researches of these two workers put modern photography upon a scientific and practical basis, and we are all indebted to them in many ways for making the practice of photography more certain and more simple. It is, therefore, fitting that their memory should be kept alive for those who follow by the proposed Memorial. The suggestion that the Memorial Fund is to be employed in the publication of the various contributions of Hurter and Driffield to scientific and photographic periodicals is excellent, and should further incite the generosity of photographers, who will directly benefit by the publication of the record of their work.

The Eastman Kodak Company has generously headed the Memorial Fund with a contribution of \$1,000. Donations from the readers of this magazine may be sent to the American Treasurer of the Fund, Prof. E. J. Wall, Department of Photography, Syracuse University, Syracuse, N. Y.

A new lens of general usefulness has just been introduced by the C. P. Goerz American Optical Co., New York, under the name Goerz Rotar *f*/8. The Rotar is intended to meet the need for a lens of moderate speed, suitable for a great variety of photographic requirements wherein crisp definition over the whole of the plate or film is the first consideration and high speed is of secondary importance. The Rotar is a thoroughly corrected anastigmat, consisting of two symmetrical uncemented combinations, free from spherical and chromatic aberration, with a flat field over the size

plate for which it is listed. For copying, enlarging, and general professional and commercial work, as well as for process reproduction, the Rotar will be welcomed by practical workers in these lines.

The 1916 Kodak Advertising Competition is something which no reader of THE PHOTO-MINIATURE should neglect. It offers ten prizes from \$100 to \$1,000 each for the best pictures illustrating Kodak advertising. The terms of the competition are simple and afford opportunities for everyone. The circular giving full details may be had on application to the Advertising Department, Eastman Kodak Company, Rochester, N. Y. The contest closes November 1, 1916, at Rochester, N. Y., and October 20 at Toronto, Canada.

Doubtless our readers have noticed the very effective black-and-white sign shown in many dealers' stores to announce Dixon's White Pencils, No. 352, which have been introduced for use on photographic albums and mounts as well as for marking and helping the high lights on dull finished black-and-white prints. The Dixon White Pencil is a new composition which gives a very desirable effect on any dark mount or surface. For signatures, titles, lining up mounts, and so on, it will be found a very acceptable convenience by both amateurs and professionals.

The May number of "American Photography" is an extra-bulky, extra-illustrated, and extra-good number. It announces that it combines "The Photographic Times" and "Popular Photography." Apart from this it represents a consolidation of no less than eight separate photographic magazines, each of which had a prosperous existence in the near or remote past. In its new form, "American Photography" offers remarkable value at \$1.50 per year, and the wonder is how it can be done at the price. The American Photographic Publishing Co., Boston, Mass.

The Sixty-First Annual Exhibition of the Royal Photographic Society, London, will be held as usual in August and September of this year. Dr. C. E. Kenneth Mees, of the Kodak Research Laboratory, Rochester, N. Y., advises me that he has been appointed one of the judges in the Scientific Section of the Exhibition and that he will be glad to receive photographs intended for this section from American workers, and to forward them to London, thus relieving American exhibitors from all difficulty and expense. Entry forms may be secured from Dr. Mees on request.

For some years the American exhibit in the Scientific Section of the Royal Photographic Society Exhibition has been of unusual interest as showing what is being done on this side of the Atlantic. For this reason it is hoped that American workers will respond to the call issued by Dr. Mees through the journals for this year's Exhibition.

The Twenty-Sixth Annual Exhibition of the Department of Photography of the Brooklyn Institute of Arts and Sciences was held in the Tissot Gallery of the Brooklyn Museum, April 27 to May 21, and was a great success, both in the quality of the work exhibited and in the attendance. The Tissot Gallery offered ample room for a pleasing display of the exhibits, so that one could view them with comfort and pleasure. Without going into details, it may be said that the Exhibition gave a thoroughly satisfactory idea of the good and serious work being done by the members of the Department, who are to be congratulated upon their interest and enthusiasm.

I was much astonished a few days ago to find that the old established house of G. Gennert, 24 East 13th Street, New York, so long preëminent in photographic supplies, has developed a very comprehensive department of motion-picture apparatus. The catalogue of motion-picture apparatus and supplies, just published by this firm, describes almost everything needed by the

"movie" worker, and can be had on request by mentioning this note.

An Amateur Photographic Contest and Exhibition is being conducted by the Newark, N. J., Camera Club, to celebrate the 250th anniversary of the city of Newark. This contest is open to all amateurs who may visit Newark and take pictures of the various events during the celebration of the Anniversary, from May 15 to October 15 of this year. The nine prizes offered in the various classes include a silver loving cup, with gold and silver medals, and honorable mention. The exhibition is to be held October 15 to 29 in the Newark Public Library. Full particulars of the competition may be had on application to Lysander E. Wright, 59 Mechanic Street, Newark, N. J.

The Newark Camera Club is one of the most active of our eastern photographic associations, with a membership of seventy-five enthusiasts, meeting twice a month at the clubrooms, 59 Mechanic Street, Newark, N. J. Lysander E. Wright is the President; Robert B. M. Taylor, Vice-President; Albert Quinlan, Secretary; and L. Wright, Jr., Treasurer; with a Board of Trustees. Readers of The Photo-Miniature should get in touch with this club and avail themselves of its many facilities and advantages. A copy of the constitution and by-laws can be had on application to the secretary.

Three big saving opportunities for camera-buyers are offered in the announcement of David Stern & Co., of Chicago, in this issue. Those who have not yet bought the new camera should not overlook these special offers.

The first of the 1916 camera catalogues to reach my desk is the Ansco Catalogue, with its beautiful cover showing a facsimile photograph in brown tones, framed in a gold matt. The catalogue is a most attractive specimen of the printers' art, but its chief interest here

lies in its showing of the complete Ansco line and the new introductions, viz., the Ansco Junior series and the Ansco V.-P. No. O in two styles. Both have many new mechanical features offering practical advantages, and the Ansco V.-P. No. O is the only pocket-camera taking pictures 1⅝ x 2½ inches, with a focusing-jacket which permits the user to take full advantage of the high-grade anastigmat with which it is fitted. Other new Ansco products described are the Ansco Filmpack Adapter and Enlarging Cyko Contrast Paper. A copy of the catalogue, together with a specimen print made by any model of camera the inquirer may select, can be had free on application to the Ansco Company, Binghamton, N. Y.

The Balance of Light and Shade in Portraiture. By W. H. Towles. 40 illustrations. Bound in buckram; price $1.50. Abel's Publications, Cleveland, Ohio. For sale by Tennant and Ward, New York, and all photographic supply dealers.

The illustrated lectures on this subject given by Mr. Towles with so much success at many of the photographers' conventions of the past two years are here gathered into a beautifully printed volume and profusely illustrated with specimens of portraiture by Mr. Towles. It is a book which no portraitist can afford to miss, and those who will read and re-read it and apply its valuable lessons in their practice will find it one of the most profitable books ever published for the professional portraitist.

Some years ago the only really safe and staisfactory darkroom lamp was that made by Wratten and Wainwright, London, and obtainable only at a very considerable expense. I am glad to note that the Eastman Kodak Company, which took over the Wratten and Wainwright business some time ago, has just put upon the American market the Kodak Safelight lamp. This is an adaptation of the Wratten and Wainwright lamp, smaller in size and price, but including all the

good features of the latter. The amateur or professional who invests in this lamp will not regret his investment.

The A B C of Motion Pictures. By Robert E. Welsh. 121 pages, illustrated. Cloth, 50 cents. Harper's, New York. For sale by Tennant & Ward, New York.

This is the last new book on its subject and in every way the best simple account of the significance of motion pictures, how they are made and shown and how the photoplay is written. Despite its small size, the book answers most of the questions asked by the average man and woman about motion pictures, and it should be read by all who want to inform themselves upon this interesting subject, whether they intend to practice motion-picture photography for themselves or not.

The amateurs of Mobile, Alabama, have organized a Camera Club, with the veteran amateur, Richard Hines, Jr., foremost among its organizers. Those of my readers who live in or near Mobile should lose no time in joining this group of enthusiasts in camera-work.

New Haven, Conn., has an expert photographer whose exclusive specialty is the making of home portraits in color by the autochrome process, described in THE PHOTO-MINIATURE, No. 147. It would be interesting to know how many color-portrait specialists of this kind there are in this country. Many professionals have introduced portraits in colors from life as a special side line, but I do not think that, as yet, we have a baker's dozen devoting themselves exclusively to this work.

The present scarcity of platinum and the consequent difficulty of obtaining supplies threaten to take all platinum papers off the market. This is an incalculable

loss to pictorial photographers, since it must be conceded that no printing medium thus far introduced can approach platinum paper in pictorial possibilities. Willis & Clements, of Philadelphia, the pioneer makers of platinotype papers, have introduced, as in part at least meeting the needs of those accustomed to platinum papers, a new printing paper, Japine Silver. This is an inexpensive paper giving brilliant sepia tones. The simplest way to try out its qualities and possibilities is to send 50 cents to Willis & Clements, 1814 Chestnut Street, Philadelphia, for which they offer to send a liberal sample of the paper and special toner, in any size up to 8 x 10.

The last issue of "The Photographic News," edited by the erstwhile wide-awake and up-to-date Carl E. Ackerman, contains a violent diatribe against present-day photographic journalism in America, damning THE PHOTO-MINIATURE with faint praise, and otherwise wickedly destructive in its criticism. The burden of Mr. Ackerman's complaint is that the American photographic magazines do not print any news. Apparently, as an example of how it should be done, Mr. Ackerman follows this criticism with a report of the Dealers' Exposition at New York which took place exactly twelve months ago, viz., April, 1915. I hear, by the way, that the most eminent personage in American photography cordially agrees with Mr. Ackerman in his estimate of his contemporaries.

Photograms of the Year 1915, after long and tedious delays because of the Great War, arrived in this country about a month ago and has met with unusual popularity. The demand for the book has been most gratifying and justly deserved, as in the interest and quality of its illustrations, as well as text, the new volume is decidedly ahead of any preceding issue. There are about eighty fine half-tone reproductions printed in toned inks and some separately mounted, apart from the thirty-two pages of text.

The pictures offer a careful selection from about four hundred prints representing the best photographic work of the year, sent to the editor from all parts of the world. America is largely represented, and there are pictures from India and Japan. The text is made up of articles describing the progress of pictorial photography in the United States, Canada, Australia, Japan, Scandinavia, Great Britain, France and Holland. It is a book which every serious worker in photography will enjoy, and can be had from most dealers. Paper covers, $1.25; library edition, $1.75.

The Folmer & Schwing Division of the Eastman Kodak Company has just introduced the Crown Printer, intended especially for professional photographers, who are required to turn out large quantities of development prints in short order. The Crown Printer comes in two sizes, 8x10 and 11x14. It is practically automatic in its action, and has several novel features which make for convenience and efficiency in its use.

The New Model Easel is another 1916 introduction of this firm, intended for the professional or amateur enlarger. The Easel is 20x20 inches, will take paper 16x20 or smaller, and is fitted with a glass plate and five masks with openings of various sizes.

Snow White Opaque, recently put on the market by J. W. Johnston, P. O. Box 578, Rochester, N. Y., is meeting with great success among professionals and commercial photographers. This Opaque has definite advantages over the old style opaques, is smooth and flexible in application, and does not dust, rub, or chip off.

"Coming Through" is an extremely interesting chapter in business romance, being the story of the development of Ansco Company, Binghamton, N. Y., based on an interview with Mr. A. C. Lamoutte, the

secretary of Ansco Company, and republished from "Printers' Ink." Copies may be obtained from the Ansco Company.

A recent circular from Ansco Company describes and illustrates the New York Studio Outfits which secured the Medal of Honor at the Panama-Pacific Exposition of 1915. My professional readers will be interested in this list and its beautiful illustrations.

FIG. 3. See page 244
A glimpse of the home with the garden will often give more pleasure and satisfaction than a mere photograph of the house alone.

The Photo-Miniature
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EDITED BY JOHN A. TENNANT

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Commercial Photography

As far away as 1903, I pointed out in these pages the many profitable opportunities open to photographers in the field of commercial photography. Later, in 1910, I again brought this field to the attention of photographers, because of its remarkable possibilities for growth and money-making. The little books which gave practical point to these urgings were warmly welcomed, and have helped many photographers to better things—which is, in a word, the single purpose and mission of THE PHOTO-MINIATURE. During the last few years, the field of commercial photography has steadily expanded, and today there are thousands of these specialist workers, generally grouped in the larger cities except where they are attached to industrial establishments; the city of Detroit, for example, having a club of commercial photographers with a membership of over sixty. To further encourage photographers to take hold of the practical advantages offered in this field, the following pages have been written and illustrated by Mr. George W. Hance, who has achieved so notable a success in general commercial photography that he is now specializing still further by devoting his skill exclusively to the photographing of homes and gardens. There is a hint here for those who read these pages aright. The requirements in commercial photography are so diversified that the skilful worker will find the easiest way to success in the cultivation of some special or particular branch of it.

For example, I know of one in New York who derives a very satisfactory income from the photographing of paintings; another who devotes himself wholly to photography for the courts, the copying of legal documents and evidence; Grand Rapids, Mich., has a firm whose specialty is the photographing of furniture, and so on. The field abounds in special lines

There is a point of difference worth noting between this and the earlier monographs on the same subject which have appeared in this series. Mr. Hance writes only of those things which he himself has done, and gives his own methods rather than any theoretical discussion of his subject. This practical handling of a theme may not always offer the easy reading provided by those who are more skilled in writing than in doing. But it has the big advantage of directness and simplicity and gives the reader the satisfaction of "getting down to brass tacks,"—virtues which too often are lacking in books written about technical subjects.—EDITOR.

Equipment

In preparing this monograph from my experience in commercial photography, I am taking for granted that the reader is already acquainted with the general practice of photography and its methods, with which professionals and most advanced amateurs are familiar. For this reason, some minor things will not be discussed in detail, my space here being necessarily somewhat limited. The equipment essential to the proper handling of commercial photography being of paramount importance, however, we must discuss this at least briefly, in order that the reader may properly appreciate the value of the right sort of apparatus and its advantages where results count. In this equipment, the lens is the vital feature.

Lenses

It is desirable, if one's funds will permit, to equip one's self with anastigmat lenses; but my experience tells me that the better class of rectilinear convertible lenses will serve almost all practical purposes equally well, with the possible exception of copying and reproduction

methods. By a convertible lens we mean that type of objective which, as combined by the maker, offers a lens of definite focal length, the component parts of which can be separated and either the front or the rear element used alone, these elements being of different focal lengths, so that in the ordinary convertible lens we have the practical advantage of three lenses of different focal lengths. For example, an 8 x 10 convertible lens of 12 in. focal length may be composed of a front element, itself a complete lens, of perhaps 28 in. focal length, and a rear element of 20 in. focal length.

Convertible Advantages

With these convertible lenses, it is possible, by possessing a battery of single elements of different focal lengths, to make up still further combinations by the use of different elements with each other, thus providing a great variety of possible focal lengths at will. My convertible-lens outfit includes lenses whose focal lengths are respectively, 12, 18, 24, and 28 in. That is, they work at these focal lengths when used singly; when used in combination, they give doublet lenses as follows: 12 in. and 18 in. combined give a focal length of 7½ in.; 12 in. and 24 in. give 9 in. focal length; 12 in. and 28 in. give 10 in. focal length; 18 in. and 28 in. give 11½ in., and 24 in. and 28 in. give a lens of 13 in. focus, all perfectly covering an 8 x 10 plate. Such convertible lenses may be had from almost all lens manufacturers, both in rectilinear and anastigmat types, and the outfit or choice of focal lengths may be varied according to the requirements of the individual worker. With the addition of a wide angle or short focus lens of about 6 in. focal length, the lens equipment may be considered complete for 8 x 10 or 6½ x 8½ in. plates.

Exposure Note

It is important to note that when the single elements are used alone, they require a longer exposure with the same stop than when the whole lens (or doublet) is used. This difference of exposure may be approximately stated as 4 times, that is, a 24-in. lens would require 16 secs. exposure, with the same stop and subject as a lens of 12 in. focal length would require. Another item to be

considered when using the single lens is that it should be stopped down more than the doublet to get the same degree of sharpness of definition. This may mean increased exposure, but in general commercial work the need for extremely short exposures is so occasional that this is not a serious handicap.

The Camera As to the camera, a good modern view camera will serve every purpose, although, I believe, there are models in the market especially designed for the ever-changing needs of the commercial worker. The important things are: an abundance of bellows length, with the bellows well supported so that it cannot sag; the double swing back, and a collapsible bed, of which the front portion can be dropped when needed. A cheap and flimsily built model should, of course, be avoided, rigidity, smoothness and certainty of operation being essential. Such a camera need not be expensive, but when the one in use becomes loose in the joints or uncertain in adjustment as to the front or back, then it may be a very expensive tool, since it is almost certain to cause loss of time and plates. Especially is lack of rigidity a fruitful cause of loss in results, often spoiling the success of an entire trip.

Two Big Helps A tripod stay, to lock the legs of the tripod when working on slippery floors or in similar difficult circumstances, is a great help to good work, and may prevent the loss of the camera by a fall or breakage. The simpler the tripod stay, the more desirable it is in portability and use. Another small but very useful camera accessory is the tilting tripod head, which allows the camera to be pointed up or down without the danger of throwing things out of balance or upsetting the apparatus.

Focusing Cloth A very necessary and conspicuous part of the commercial worker's equipment, too often neglected, is the focusing cloth. It is well worthy of attention. A good focusing cloth, light and compact, may be made of Italian cloth, which comes in yard and one and one-half yard widths, is fairly light in weight and thoroughly opaque. See that the loose ends are hemmed. Get the habit of

folding it after using; it will look and wear better and take up less space in the kit. A little care and order put into the arrangement and packing of the kit makes for after-efficiency, and gives a favorable impression to the customer.

Plates and Papers

While in portraiture speed and fine gradation are sought for, in commercial work we want more snap and definition and also general sharpness of definition from corner to center of the plate. I am speaking of the kind of photography which is in demand in the general business world, such as catalogue illustrating, salesmen's samples, and architectural work. The preference on the part of some for indefinite, soft, fuzzy pictures, such as take prizes in pictorial exhibitions, can hardly be classed with what we are called on to make where we work at the business for a living, and some good photographers, with the prospects of building up a good business, have lost their chance by trying to work off on their customers these so-called "artistic" pictures. Art is one thing, but commercial photography is, as Kipling says, quite another story.

Double-coated Ortho Plates

For general work, a double-coated plate with orthochromatic qualities is best, as with these properties we have a chance to make our exposures long enough to get into the shadows and still not block up the highlights, where there are extreme degrees of contrast in the subject. An interior, for instance, where we work against the extremes of dark corners and also have windows to contend with. Here such a plate will pick up the detail in the heavy shadows in the fast emulsion, while the slow emulsion underneath will hold the highlights from building up too fast. The orthochromatic quality will also give good separation of the colors such as are most commonly met with in such subjects. For machinery, stoves, automobiles, and similar subjects, the double-coated plate is a necessity. If fast exposures are required, the fast emulsion of these plates will be found quick enough for reasonable exposures, but you will not get the benefit of the lower or slow emulsion unless you time your exposure for the shadows.

Color-sensitive Plates

For copies of documents, paintings, architect's sketches and blue-prints, a color-sensitive plate of greater sensitiveness to colors will be found an advantage. These plates are called isochromatic or orthochromatic, and the more sensitive ones panchromatic or spectrum. These last are sensitive to all the colors, and should be used with great care and handled in total darkness. Their value is made use of only when used with a ray filter or color screen, the use of which will be discussed in later pages.

Contrast Plates

For extreme contrast, as in copying a drawing, a "contrast" plate will be found best, and in these the shadows will be nearly clear glass in the negative, while the highlights will be very dense. The general worker will do well to have some of all these kinds on hand, that he may be ready for any kind of a job which may come his way.

The line of plates mentioned as double-coated are the Standard Orthonon, Seed's double-coated Ortho, Cramer's double-coated Iso and Isonon, all of which are color sensitive. Seed's Nonhalation and Hammer's Aurora are excellent for work with strong contrasts, which must be reproduced with equal qualities in both highlights and shadows, as, for instance, in photographing stoves and furniture, but which have no decided colors which need separating.

The writer is wholly impartial as to whose make of plates he uses, but is familiar with the above and advises them with confidence, as he does the Cramer Contrast as a plate which will give him the extreme of contrast, the Wratten Panchromatic, and the Cramer Spectrum, where there are difficult colors which need rendering in their proper relationship, as in copying a painting. For general landscape work and interiors, the Standard Orthonon is the plate he uses most, and a light yellow ray-filter generally goes in the kit. With its aid, a flat view, or one with clouds or gardens, will come out a brilliant negative where otherwise it would be quite uninteresting. Note that ortho plates and color screens always mean more vigorous negatives.

FIG. 1. Nos. 1 and 2. See page 244

FIG. 2. Nos. 1 and 2. See page 244

Papers

Prints for reproductions, such as catalogue work, should be on some glossy paper and be squeegeed to retain the glossy surface in the finished print. Solio or Kresko, both printing-out papers, are splendid, but should be toned to a deep brown, or until the yellow is out of them. Developing papers are so common, and there are so many good ones on the market, that a choice is easy; but be sure of one with a glossy surface. The same kind of paper, either in double weight or, if single weight, backed with regular backing paper, or cloth, makes good sample prints for salesmen's use, or where the prints are to be bound for record.

For view and landscape work, where the prints are not to be reproduced, a semi-matte or dull paper is better, and should be chosen with a view to the effect wanted. Some of those who are getting the good prices are using platinum paper, and find that only with such a product can they get away from the common run of output and get their price. The method of finishing such prints will be discussed later.

View and Architectural Work

Under this heading we have landscapes, exteriors and interiors, construction work and groups. We need here a good view camera of about 8 x 10 size, and if we have an 11 x 14 we shall be able to make many jobs on that with but a little additional cost, and get twice as much for our work. For lenses, we shall need a wide angle for our interiors, and a lens equal in focal length to the long dimension of our plate. A longer focal length would be even better. But one of the convertible lenses rated for an 8 x 10, or even a $6\frac{1}{2}$ x $8\frac{1}{2}$, giving us single combinations of longer focal lengths, will do nicely.

Importance of Focal Length

The idea of the longer focal length being used in preference is that it gives less in width of view angle, and requires us to move further back to get the same range, or extent of view, than one of shorter focus, and thus we get the picture more as the human eye sees it in the original. Objects appear in better proportion, or, as it is commonly expressed, in better "perspective."

Nearby objects are not so much larger than those farther away. If we use a short-focus or wide-angle lens on an automobile, for instance, and work to show the front and side, we shall be so much nearer the front wheels than the one seen in the rear that they will appear much larger; while, if we use a longer focus lens, we shall have to get back farther, and the relative distance between the camera and front wheels and the camera and the rear wheel will be lessened, so that they will be rendered in truer proportion as to relative size. Cultivate your appreciation of perspective.

Figures 1, 2, 3

The same applies to a group where the people are arranged in rows; if we use a short-focus lens, the people in the front row will appear larger than those in the rear, because the lens is so much nearer them. In photographing a house with nice grounds about it, the grounds should be made to show to as good advantage as the house itself, even if all the front of the house does not show. In the case of the house shown in the accompanying cut, Fig. 1, No. 1 is the front of the house, but the view from the garden side in No. 2 is much more pleasing as a picture. The same is true of the home shown in Fig. 2, where the house is shown in No. 1 merely as the house, while in No. 2 the view across the terrace is much more pleasing as a picture. Your customer may not see these pretty views till you show the prints, but it is your business to see them and point them out, the same as an architect anticipates his client's wishes and makes sketches and drawings. Many times a little glimpse of the home in connection with the garden will please, without trying to show all of either. Such a case is illustrated in Fig. 3, which serves as the frontispiece of this number.

Interiors

While speaking of homes, let us consider the matter of the interiors. As a rule, a wide-angle lens will be found necessary to include what the customer wishes, although we should avoid going too far in this respect, or we shall get distortion or false perspective. The room will appear much larger in the picture than it does to the eye, and any furniture in the foreground or at the ends

FIG. 4. Nos. 1 and 2. See page 247

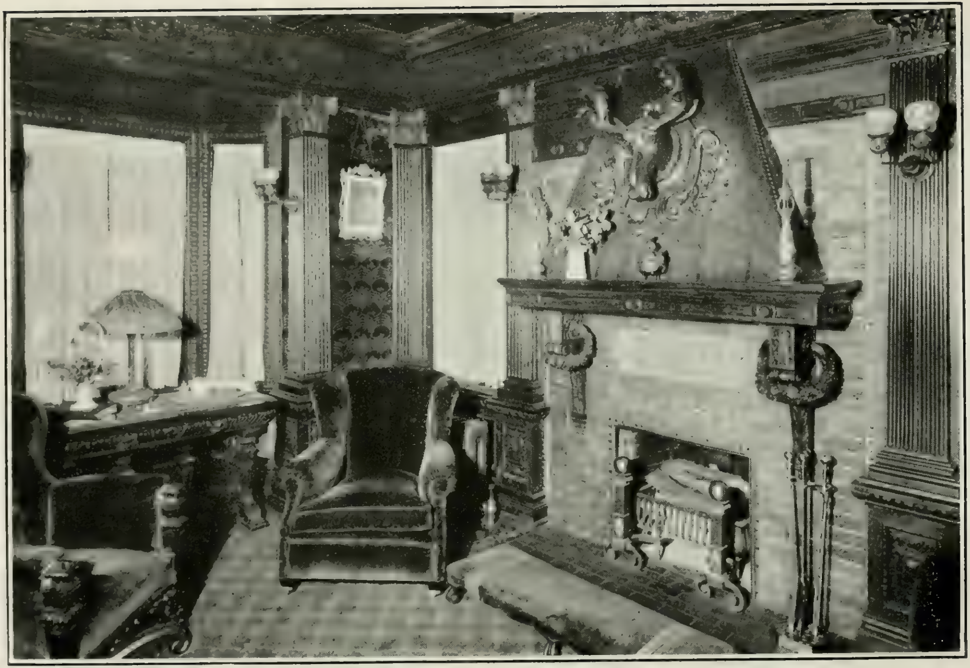


FIG. 5. See page 247

of the picture will be distorted. A safe rule to follow is to select a lens about equal in focal length to the short dimension of the plate, or possibly a little shorter. Therefore we should have about a 7-in. or 8-in. lens for an 8 x 10 plate, and not shorter than a 10-in. lens for an 11 x 14 plate. The interiors which are shown in Fig. 4 were made on 8 x 10 plates with a 7-in. lens. The plate used in each case was a Standard Orthonon. Very often we can get a corner of a room as shown in Fig. 5, or a feature as is shown in the homelike fireplace in Fig. 6, which are exceedingly interesting with a longer-focus lens. A 9-in. combination of the convertible lens mentioned previously was used in both of these.

Arrangement

In arranging a room for a picture, care should be taken not to get any one piece of furniture to show too conspicuously; and where the room will admit, you should show an unbroken distance of floor to the extreme end of the room. Referring to the room shown in Fig. 4, No. 1, you will see that the size of the room is well suggested by our being able to see down the room to the windows without any interruption by a piece of furniture. This is an important advantage.

Windows: Halation

When working against windows, and they are always an addition to a picture, care should be taken not to get halation; which is sure to result if we expose enough to get into the shadows and do not take care of the over-exposure of these highlights, either in making the exposure or in after manipulation with the developer.

Where possible, it is better to make use of dark opaque shades, or, if they are not at the windows, hang just inside of the glass, curtains (which it will pay you to carry) made of turkey red outing flannel or canton flannel. This device is neither bulky nor expensive, and will save you much time in after manipulation. Long exposures with the curtains protecting the strong light, followed by a short exposure after the curtains have been removed, will give the best and easiest results. Sometimes, however, it is either impossible or impractical to attempt to cover the windows. In such cases, make your exposure for the deepest shadows

and ignore the highlights, then mix your developer with merely a trace of carbonate of soda to start with, which will prevent the highlights from overdeveloping, and will allow the shadows to build up equally with the highlights. After prolonged development,—and it will take from fifteen to thirty minutes to fully develop such a plate in this modified developer,—it is well to immerse it for perhaps half a minute in normal developer, to snap up the highlights a little, otherwise it may be a little flat in effect.

The Developer

A developer which the writer has used to advantage, and the results of which are shown in Fig. 7, Nos. 1 and 2, is as follows: Water, 40 ounces; metol, 6 grains; sulphite of soda, 2 ounces; hydroquinone, 30 grains. Time to develop about thirty minutes at temperature of 65° to 70° Fahr. A nonhalation plate is practically necessary in such cases, as you need the two coats of emulsion which such a plate will give you.

Exterior and Interior View Combined

An extreme example of the results obtainable by covering the window with turkey red flannel for the exposure of the interior of the room, then removing it for the view of the exterior, is shown in Fig. 8.

Another point we should consider in setting up our camera for interiors is to be absolutely sure it is level; for this purpose a small pocket level will save both time and uncertainty where the light is poor. It is usually a good point to drop the lens board so the lens will be below the center of the plate, in this way getting more foreground than ceiling, and thus being able to avoid cutting off the legs of furniture, and also giving the idea of greater size to the room. A tripod stay will save you the uncertainty of your camera falling because of the slipping of the legs, and will be worth many times the dollar it costs.

Supplementary Illumination

In many interiors there is not sufficient daylight to some parts of the room to insure you of getting any impression on the plate. In such cases some artificial light is necessary, and any of the lamps offered for home-portrait work will be found quite satisfactory.

FIG. 6 See page 247

Fig. 7. Nos. 1 and 2. See page 248

The writer confesses to a certain amount of prejudice against flashlights, although some of the most successful operators are using them. They suggest to the customer a certain danger from fire, even though they be inclosed in a bag, and the shadows are almost sure to be sharp and contrasty. The electric lamps which use either a small arc or the Mazda lamps are much more satisfactory, and, while they will require more exposure,

FIG. 8

still the results will justify the extra time. They admit of being moved around the room during the exposure and, in thus enabling us to break up the shadows, they offer a practical means of getting much the same quality in color values that daylight does.

Exposures

The length of exposure required for interiors varies so much with the lenses, plates, and general conditions of light and the colors of the subject that it is impossible to give any definite guide, although it is safe to say that with a wide-angle lens working at about *f*/32 and a non-halation plate, the interior of an average living-room will require an exposure of from five minutes up. Less

exposure will be likely to give a harsh negative, and the writer is strong on long exposures, to insure detail in the shadows. Start the development with not over half the normal amount of carbonate of soda, adding more as the development progresses. The stronger the contrasts in the subject, the longer the exposure, as with the double-coated plate prolonged exposure will flatten the image and you get the benefit of the slow coating which is next to the glass. The quantity of water used in normal development with ordinary plates should be increased in using these plates; about twice the amount is safe. This is necessary, or otherwise you will develop the upper emulsion before the developer has had a chance to get soaked through to the lower film.

Tank Development

The tank has been found to be a very desirable method of developing interiors, but where the exposure has been much prolonged pyro is not advised as the developing agent, as it tends to give too much flatness. Glycin is excellent and the following formula is a good one: *Stock Solution*: Hot water, 120 ounces; sulphite of soda, 1 ounce; glycin, 1 ounce; carbonate of soda (E. K. Co.), 4 ounces (other makes, 5 ounces). To develop, take: Stock solution, 15 ounces; water, 141 ounces (for 8 x 10 tank). Develop 30 minutes at a temperature of 65° Fahr.

Furniture

When it is possible, such articles of wood construction as furniture, doors, and the like, should be photographed before they are filled or varnished. They should first be treated with a wash of gasolene and kerosene in the proportion of half and half; this will bring up the grain with all the contrast which the final finish would show, and the highlights will not have the yellow tinge which varnish gives. This treatment also obviates all glare and reflections in the finished article. There is no objection to the application of this wash, as it will all evaporate in a few hours, and the wood will take the ordinary finish desired by the maker as if it were in its original state. If a small piece is being handled, less kerosene can be used, its only purpose being to keep

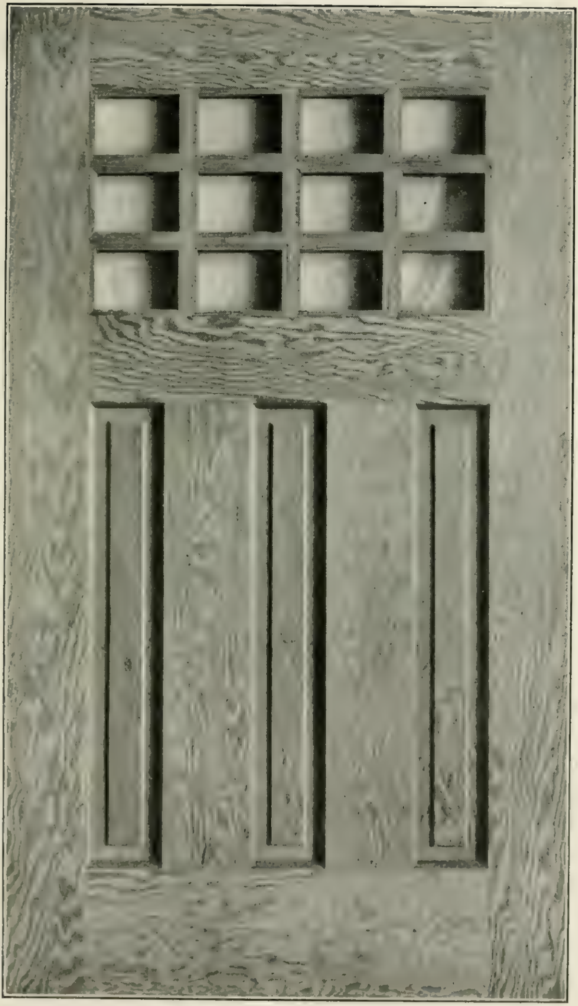


FIG. 9. See page 255

FIG. 10. See page 255

the gasolene from evaporating too quickly. It is the gasolene which brings out the grain. If there should be any objection to the using of gasolene, as is sometimes experienced where you are called on to do the work at the factory, you can get the same results by the use of cedar oil. This is more expensive and takes longer to evaporate, but the grain will show up with brilliancy.

The Lens

A long-focus lens is quite imperative in this kind of work, as with a short focus you will get distortion which will be worse than lack of grain. A lens whose focal length is at least one and a half times the long dimension of the plate used should be chosen. One of 18-in. focus at least for an 8 x 10 plate is recommended, and a good rapid rectilinear will answer far better than a better lens of shorter focus. Of course, a better lens (anastigmat) will admit of being used with a larger aperture, which will shorten the time of exposure, and so is always advised where practical. The camera should have a swing back, so that, if you are called on to tilt the camera, you can swing the back to keep the lines of the object straight. The side swing, which is but little used, can also be employed to good advantage in this class of work.

The object should not be lighted with a flat light, no more than you would place a person you are to make a picture of with his features lighted equally on both sides. Let your light fall across the object, and a little from the top, which will bring out the relief. In the accompanying cuts, as shown in Figs. 9 and 10, the panels of the door are promptly brought to your attention because the light was brought from the side, and the dresser shows projecting scrolls at the ends and the curves to the drawers at the top, by the degree of light and shade indicated.

Ortho Plates an Advantage

Plates for this kind of work do not need to be double-coated, but should be slow and crisp-working. We should have a plate with orthochromatic quality, as we shall need to separate the color to get grain, and, in case the grain is not so distinct as we should wish, we can use a ray-filter to advantage. Such plates as Cramer's

Isonon or Slow Iso, Seed's Ortho, Hammer's Slow or Aurora, Standard Slow Ortho, or Orthonon and Stanley Commercial are especially recommended for this class of work. Any of these can be used with a light yellow screen or filter if more grain or contrast is desired, but for the greatest possible contrast a Panchromatic plate with a deep yellow or red filter is advised. The idea of the filter is to separate the colors, and allow the yellow and red to come through as if they were of lighter tone. More about the use of filters will follow in a later chapter. The slow plates have a heavy emulsion and will give negatives of good body, which is a decided advantage in this kind of work, as they will yield prints of more strength without great contrast.

Polished Woodwork

When the furniture is filled and varnished, greater care in the method of lighting will be required. To get rid of the glare of the varnish, it will be necessary to intercept the light which falls on the subject. A good method is to make a tent or canopy of white muslin, and place it so that all the light falling on the subject will be filtered through this cloth. This will break up the glare and diffuse or distribute the light so that quite satisfactory results are obtainable. The use of a filter will result in a further absorption of the highlights, so that the detail will be more perfect. But the mere hanging of white muslin on either side and across the top of the subject, if necessary, will afford wonderful relief from the spots of glare otherwise obtained.

The matter of blocking-out the negative will be discussed later. (See page 267.)

Stoves and Metal Work

Stoves are without doubt the most troublesome articles we have to contend with. Fortunately, they are not met with by the general worker, as their manufacture is limited. But, if we know how to treat a stove as to preparation and lighting so as to get a desirable picture of it, we shall have the basis for photographing almost any metal article. The reason a stove is so hard to photograph with any satisfaction is that it offers the two extremes of contrast—the dead black of the body, and the highly polished nickel trimmings. The black

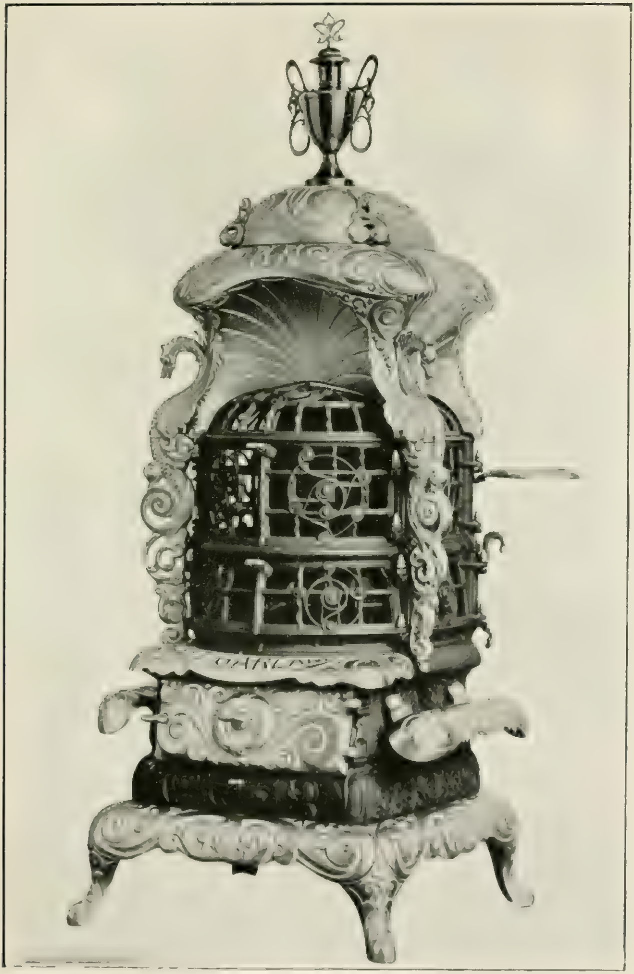


FIG. 11. See page 258

absorbs the light, while the bright metal parts reflect all that reach them, with the usual result that the negative is harsh and contrasty.

Preparation The simplest means of preparation is to paint the black portions with what is commonly known as "flat black," a paint which can be secured at any paint store, and gives a uniform fine-grain dull surface. If a little more of the gray tone is desired, a little white can be added to the flat black which will give more brilliancy to the iron. The trimmings should be gone over thoroughly with a ball of soft putty, kept soft with olive oil or castor oil. If you have large, plain surfaces to be treated with the putty, you can use a small printers' roller to advantage. With it roll out the putty much as a cook rolls out a batch of dough, then go over the metal with the roller, and a deposit of the oil from the putty will be left on the metal. Repeating this process and overlapping the strips, you will cover the surface quickly and uniformly. The streaks where the overlapping occurs can be blended easily with a tuft of soft absorbent cotton. Where there is lettering in the trimmings, which should stand out in good contrast, it is well to use the printers' roller with the flat black paint over these raised letters, and allow it to dry, before applying the putty. After the putty has been patted on, it can be easily wiped off where it smears over this black, and the results will be as seen in the Art Garland Stove shown in Fig. 11.

Using the Hand Screen After the above treatment of the stove, the matter of lighting is comparatively simple; but the use of screens of white muslin will help immensely in giving a uniform light, and the same method of using them as you would employ in making a portrait will be needed. These screens should either be mounted on frames or suspended from wires so they can be easily adjusted, but all the light should come filtered through the muslin, which will soften it and avoid the harsh contrast otherwise encountered. By a little manipulation of the screens you will be able to get any effect you wish, and all the design and light and shade of the original.

Two Important Points

The choice of a plate is vital to success in this class of photography. As you have the detail of the intense black and the bright trimmings to work for, we need a plate with sufficient latitude to hold the strong highlights, and at the same time get into the shadows of the dead black. Such a plate is one with two coatings, one with a slow emulsion and on top a fast emulsion, which will admit of sufficient exposure to get into the deepest shadows, and it should be exposed for them without consideration of the highlights, which will take care of themselves.

The focal length of the lens used is of great importance, and one of at least twice the long dimension of the plate is necessary,—that is if results like that shown are wanted. A lens of shorter focus will give bad drawing or perspective. In the case of the stove shown, a 10 x 12 plate and a lens of 36-inch focus were used. This particular lens was not of the most modern type, but one of the older large lenses corrected for rectilinearity, with a speed of *f*/9 only. But, as the lens should be stopped down some, this is amply fast for anything in the commercial line. Long exposure and a soft-working developer are the keynotes of successful manipulation.

Scales: Cash Registers

The method here outlined is employed for such articles as shop scales, cash registers, metal drills, and steel tools generally. Scales and cash registers should not be doped at all, but merely screened by the white muslin, drawn along either side and a piece placed across the top, thus making a tent or canopy over it. Thus the light will be softened and diffused, and all glaring highlights will be avoided. A double-coated plate should be used, which will allow an exposure for the deepest shadows and still not burn up the highlights. The cash register was first puttied, as described above, and then placed under the same canopy, with quite satisfactory results. The steel drills need not be treated in any way, as every bit of contrast is wanted to bring out the twists and grooves, but may be laid out on a board with a prism in front of the lens. The

camera is pointed in a horizontal position so that the prism will look down onto the drills. This will save the necessity of fastening them on a board to set up in front of the camera. The addition of such a prism to a good lens used for commercial work will be found exceedingly useful in many cases where small articles are to be photographed, but it must be remembered that a prism reverses the image, as the effect is the same as looking at an object in a mirror which is set at an angle of 45°.

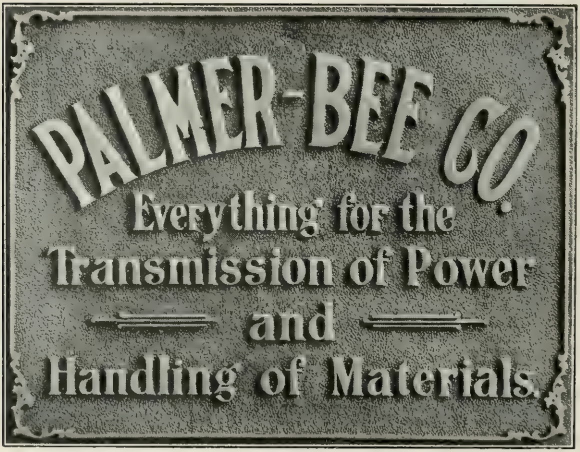


FIG. 12

The cast iron name-plate, Fig. 12, was simply a dull piece of iron with no contrast. The relief was brought out by strong lighting from the side, the dull iron catching a little highlight and casting shadows bright and strong. It is the opposite extreme from the matter of the stove, where we wished to avoid too great contrast. The plate used here was a snappy, clear-working plate, developed for great contrast. With all subjects of this class the question of illumination is the vital detail in getting a satisfactory record.

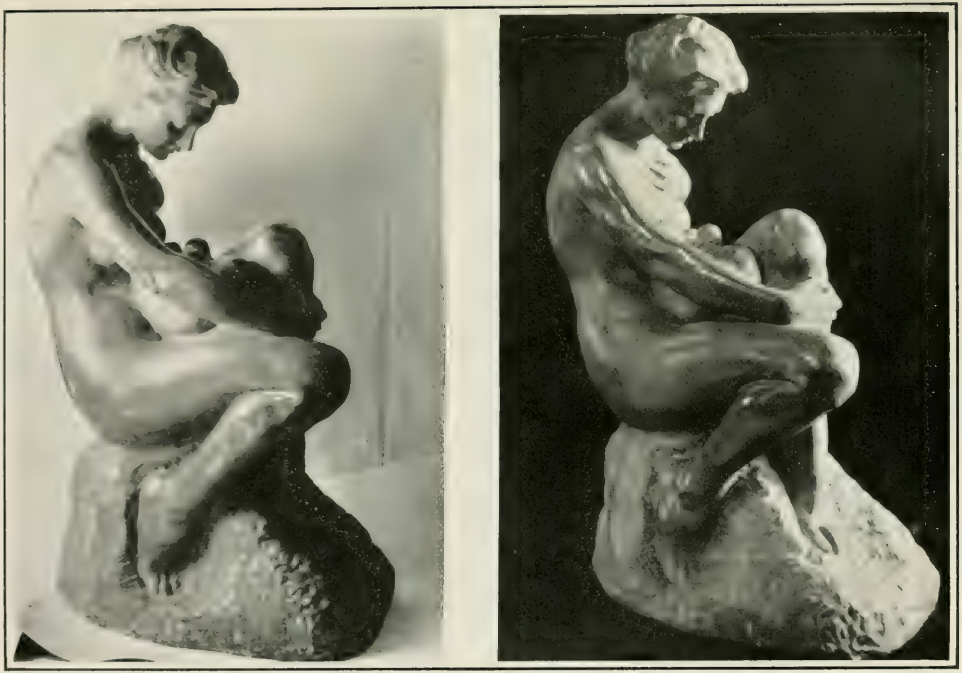


Fig. 13. Nos. 1 and 2. See page 263

FIG. 14. Nos. 1 and 2. See page 264

Using Artificial Light The use of an artificial light, such as was suggested for interiors, is a great help in making negatives of any of these subjects; but such a light should be used with a screen in front to break up the sharp shadows. A piece of architect's bluish white tracing cloth is splendid for this purpose. By the use of such a light you can shorten the exposure materially, as well as get into the shadows with light, which otherwise would be quite impossible to get detail of. It is obvious that such a light will also give you strong contrast when placed well to one side of an object like the iron name-plate.

Bronzes The writer has recently had occasion to make negatives of some beautiful bronze statues. That is, they are beautiful to the eye, but, when you come to photograph them, the dull bronze color does not give the brilliancy which the eye sees. Their being of one solid color requires that the modeling be brought out by snappy highlights and good deep shadows, yet with detail in the shadows. For such work the best results are secured by the use of a double-coated plate with color value, and the light from a 1,000 watt tungsten lamp, used in a reflector known as the Holophane BEE—1,000, with the light screened by the use of two thicknesses of tissue. The results are shown in Fig. 13. A large iron grille, standing in a dark part of a room, was also wanted, and the daylight did not show the beauty to the eye, so of course the plate would not get it. By the use of this same 1,000 watt lamp, the results secured were all that one could ask for. The plate used was Standard Orthonon.

Silverware To deaden the reflective power of the bright metal, it is necessary to coat it with some substance which will give a brilliancy and yet dull appearance. The most common medium for this is putty, which can be easily daubed on without any damage to the surface, and at the same time gives an even velvety deposit which photographs nicely. The engraving or stamped design in silverware can be brought out in relief by rubbing on first an oily shoe-polish — black — which will leave a little of the paste

in the cutting, or at the base of the raised design. When puttied over, this gives a desirable contrast with the main part of the article; and, if the putty appears uneven, it will blend nicely with a tuft of canton flannel or absorbent cotton.

Results such as are shown in Fig. 14 are obtained, as these were treated in just this way. Another method at present advised is mixing tripoli, a very fine polishing powder, which can be obtained at the druggist or jewelry store, with pure lard oil, to the consistency of a thin paste, and patting it on with a tuft of cotton. In either case, it will doubtless be necessary to surround the article with the tent or canopy described in the treatment of polished furniture and stoves, which will diffuse the light so you will not get too great contrast in your rendering of the subject.

Cut Glass

Cut glass can be puttied the same as silverware, but a better way is to spray it with aluminum or gold bronze, and then dust it over with very fine graphite. A sizing of thin glue or gum arabic, drying thoroughly, then polishing with "Rising Sun" stove-polish, will be found to give a splendid surface. If the glass is etched, the same treatment with the shoe-polish and tripoli will serve nicely. One of the simplest and most satisfactory methods which the writer has used is to mix a package of "Blue Diamond" dye with the prescribed amount of water as for dyeing, and adding 2 drams of gum arabic. This can be put on best by spraying, either with an air-brush or an atomizer.

After coating the surface with any desired method, the lighting must be handled with care. To get the effect of the cuttings, we must get a pronounced contrast between the surface and the facets. A box—one the size of an ordinary 8x10 box holding 12 dozen plates—will do nicely for a small article like the olive dish shown in Fig. 15, and at least ten inches deep—lined with black velvet (or turkey red canton flannel will do in a pinch) with both covers removed, into which the article can be supported so the black lining will reflect into the cuttings. A white background can be placed some distance back of the box, which will,

of course, be open front and back, so the outline will be good.

A much simpler way is to set up black dull reflectors on either side of the article, and light it completely with one of the tungsten lamps previously referred to. A 1,000 watt is quickest and gives best results, but one as low as 250 watt is quite satisfactory.

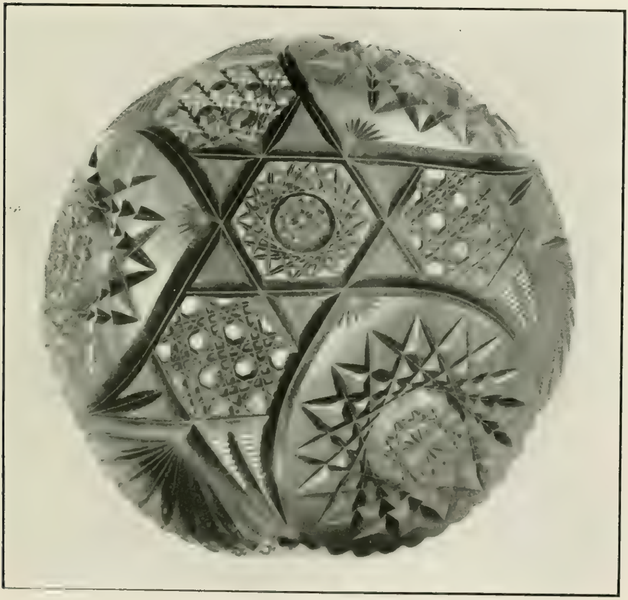


FIG. 15

The group of loving-cups shown in Fig. 16 required further treatment than ordinary, in that there were some dark green cups with the two bright silver ones. To get the lettering in these, chinese white was rubbed into the engraving of the green ones, and then puttied over the same as the silver ones, which were treated with the shoe-polish and putty.

FIG. 16. See page 265

Blocking Out Negatives

To produce a white background about a commercial subject, such as a machine, it is not practical to attempt to use a white sheet or other white background with the idea that it will be white enough in the print. To get this effect, it would be necessary to over-develop the plate and make the print on too contrasty a paper, with the result that the highlights of the subject will be too white and all detail will be lost. A better plan is to develop the plate with no regard for the background, and, when dry, block it out with any prepared opaque, which can be procured either in brick form or in a thick paste, such as Johnston's Snow White. The latter is best, as it does not dry so brittle and crack, but this difficulty can be avoided when a solid, brick form of opaque is used by the addition of a few drops of a thick syrup made of gum arabic. This gives a little elasticity to the opaque, which will help to make it spread nicely and avoid the tendency to crack when dry. Prepare the opaque so that it will spread easily and evenly, without streakiness, and so avoid two applications.

Working With Opaque

As to the method of outlining the image, it is best to trace around it with the opaque in a ruling pen, such as draughtsmen use in drawing plans. The black ink these same draughtsmen use does nicely to outline the image also, although Snow White runs easily from such a pen. We can go still further in borrowing ideas from these men by making use of their rulers and irregular curves to help us trace the exact outline without the danger of running into the image. Many a photographer tries the difficult task of tracing a straight line of a piece of furniture, when a more gifted and skilful draughtsman would not think of attempting it without the use of a straight edge. After the article has been outlined in this way, it is an easy matter to go to the edge of the plate with the opaque applied with a good-sized camel's hair brush. To prepare for this work, it is best to procure about three sizes of brushes, a metal edged ruler, two irregular or French curves, and a supply of opaque.

Varnish Your Negatives If there is difficulty in making the opaque take to the film of the negative, flow the plate with any good varnish, such as are put up for retouching or preserving negatives. A splendid coating is secured by the use of "Adamantine" varnish, which most stock houses can furnish. By the use of this varnish, you can wipe off any opaque which may have run over onto the image and which you wish to remove, without danger of injuring the film.

After blocking out the negative, it is well to again flow the plate with the same varnish, which will protect it from damp fingers, or the danger of the opaque being rubbed off from frequent friction with paper in printing. Also, if there is a tendency to crack on the part of the opaque after it is thoroughly dry, or after it has been stored for some time, this after-coating of varnish will prevent it and preserve the coating.

Holding Back Thin Shadows Many negatives are full of detail in the shadows, but, as they are too contrasty, the detail is lost in the print if we print deep enough to get through the highlights. If it is not practical to reduce the negative to balance it up properly, it is an easy matter to hold back the shadows either by applying some suitable hold-back to the back of the plate, or by pasting tissue paper over the back of the printing-frame and rubbing into it some lamp-black or crayon-sauce. Hold the frame with the negative in it up to the light, so that you can look through the negative, and rub the black in with a tuft of cotton on the tissue paper where the shadows of the negative are thin. A little practice will be necessary to secure the correct amount of black.

Many printers prefer to apply prussian blue to the back of the plate where the thin shadow is, patting it till it is thoroughly even. It will hold back a little and is permanent on the negative. A still further method is to flow the back of the plate with ground-glass substitute, and rub into it, where the thin places are, the lamp black. However, the writer prefers to have the hold-back farther away from the print, and when applied to tissue it will blend better.

More Dodging

Many furniture negatives can be improved by building up the grain by flowing the back of the plate with this ground-glass substitute, and then working up the highlights with the use of a wax pencil, which can be procured from the stock house. Many times you can work in a separation between two parts of an object which were lighted so that they fall against each other in the same degree of tone, by this same means. If the sky in a landscape negative is thin, flow the back of the plate with the ground-glass substitute, and work in a little cloud effect with lamp-black and a tuft of cotton. You will be surprised to see how much you can improve an otherwise flat print by the use of the wax pencil to build up little highlights in various parts of view and architectural subjects.

Ground Glass Substitute

To those who are doing much with ground-glass substitute the following formula is given, as the purchase of it in small bottles is quite an expense. Squibb's sulphuric ether, 15 ounces; gum sandarac, 1½ ounces; benzol, 6½ ounces. Be sure you get benzol, and mix in order given.

Local Intensification

It is a much better plan, however, to intensify the shadows, and the writer prefers to do this local intensification with the following mercuric-iodide intensifier. Prepare two solutions, viz.: No. 1—Water, 6 ounces; bichloride of mercury, 2 drams. Dissolve thoroughly. No. 2.—Water, 6 ounces; iodide of potassium, 2 drams. This should be a saturated solution. Stir No. 2 into No. 1 a little at a time. A red precipitate will form, but by the continued addition of No. 2 it will clear up. Stop when perfectly clear, and add 1 ounce of hypo crystals.

For local intensification with a swab of absorbent cotton, it is best to use this diluted with an equal quantity of water. If the negative needs intensifying all over, immerse into this intensifier at its full strength. If the negative has a decided yellow color which appears too strong, immerse for a few seconds in the regular fixing-bath, when it will clear up. Too long an immersion in the hypo bath will take all the intensification out. Watch the clearing process carefully.

Prints

In a previous chapter, mention was made of the kind of prints most commonly considered in connection with commercial photography, namely, glossy-paper prints. These are in demand for all work which is for reproduction, or for salesmen's samples where full detail is wanted. Such prints also are commonly used for record, in which case it is most common to hinge and bind them, much as modern records are kept, in a loose-leaf binder. For this purpose single-weight paper is best, and it should be mounted on linen, and they should have a hinge for the binder.

Backing Prints with Muslin

The method of mounting them is simple. Provide a supply of ferrotype plates, thoroughly cleaned and waxed with gasolene or benzine into which a little paraffine is dissolved. The proportion should be about eight ounces of gasolene and a piece of paraffine the size of a hickory nut. More paraffine will do no harm, except that it may make the tin too greasy and the print coming from the plate will look streaked.

After the plate is washed to remove all paste, sprinkle on a little of this dope and polish the tin thoroughly, thus removing all the surplus wax. Have the print thoroughly wet, lay it face down onto the tin plate, and bring into perfect contact with a velvet squeegee. A roller is not sufficient, as it will leave spots which are not in absolute contact. If the print is to have a hinge, it is necessary to trim the hinge end of the print before putting on the tin. For cloth backing, any good bleached muslin will do. It should be firm rather than fine. Have it wet up well, paste with a flexible paste and mount onto the back of the print which is already on the tin. It is well to cut a strip for the hinge end, from a roll of backing paper, or old prints can be cut up for this purpose. Wet the strip and lay on the tin, with a little separation between the strip and the tin, before pasting on the linen back. Bring the cloth well into contact with the back of the print with the velvet squeegee, which will also force out all surplus paste. Allow the print to dry slowly, as drying with heat or a fan is likely to make the print dry too fast at the edges,

and it will not come off evenly. It is best to dry the print flat, as by standing on end the top will dry first. Have the cloth a little larger than the print, so it will stick to the tin and form a binder to hold the print until it is thoroughly dry.

Mounting Paste

A good paste for this purpose is made as follows: Gloss starch, 2 ounces. Dissolve in 2 ounces of cold water, then stir into 18 ounces of *boiling* water into which has been dissolved about 50 grains of powdered alum, and 12 drops of carbolic acid. There is a flour paste on the market which the writer has used for thousands of prints with splendid results. It is called Stek-O, and is procured from wholesale paper houses. It comes in 1-, 2-, and 5-pound boxes, 25-pound pails, and 100-pound kegs. Directions come with it, and it is one of the most economical pastes for this work. It does not sour, but should be strained through cheesecloth from time to time.

Matt Paper Prints

If a semi-matt or matt paper is used and the prints are to be backed with linen, it is best to stretch the cloth on a frame and mount the prints onto it, allowing them to dry with the surface exposed. Or you can mount the linen onto the back of the prints, which are laid out on glass, then lay out on blotters till surface dry, when they can be piled up between blotters till nearly dry, then put into a press with blotters between.

A Profitable Hint

Many commercial photographers lose their chance of getting better prices for their work by letting their customers be satisfied with these glossy prints, when they could just as well get them to take matt-surface prints at a much better price. As a rule, the glossy prints are sold at a close price, and if you can get the customer to consider something different you get away from this price competition. If he is an architect and you have made the glossy prints for reproduction, show him some sepia enlargements on a good paper like Royal Bromide. They command a good price and, as you have the negatives, they will increase your profits.

If he wants a set of hinged prints for his office, suggest a semi-matt double-weight paper, with the

prints matted out on paper of a larger size. You can make the hinge with a strip of hinging cloth tape, which the stationer can furnish if your stock house does not have it. It is gummed and holds firmly. The average 8 x 10 negative printed by this matting method on 11 x 14 paper will command a far better price than the straight 8 x 10 print, with but slight additional extra in cost to you.

If the subjects are exteriors, offer the customer prints on carbon green paper. They will not look like common commercial prints, and you will again get away from the competition of the lower-priced glossy black print.

For strictly high-grade work, there is nothing to compare with genuine platinum paper and, if the customer can be made to see the advantage, you might as well give him the best. Put the platinum and all matt-surface prints up in individual folders such as are used in portrait studios, and make your own folders from carefully selected cover papers. One trouble with the average commercial man is that he is accustomed to meet competition, and thinks that he must figure low to get the business; while, if he would seek these opportunities of offering something better, he would find there is a good market for the better grade of work.

A splendid way to improve the appearance of a print is to double-print with a good border mask, which most dealers carry in all stock sizes. This relieves the plain white border, and makes it easier to get a higher price for the finished print.

Photographing Colored Objects

Having now disposed of some of the problems likely to be encountered by the commercial photographer, I turn at the last to the problem of photographing colored objects, perhaps the most important of all because it underlies almost every branch of commercial work.

Let me say, at the outset, that I know of no detail of commercial photography which is more interesting, more worthy of study, or more likely to be profitable to the professional worker than the knowing how to deal with subjects which have color—and how few of our subjects are without color! It involves the use of

specially sensitised plates and color filters—just modern orthochromatic photography, and its purpose is to secure in the photograph a record of the subject photographed just as the eye sees it.

Color Luminosities

Briefly, this means getting a record of the subject with its color luminosities correctly rendered. In most cases it is the difference between a successful record which will please the customer and one which does not satisfy, simply because it does not truthfully record what the customer sees in the subject photographed.

By correctly reproducing the color luminosities of the subject, I do not mean reproducing the colors themselves, but simply their true relationship of tone values as the eye sees them—translated into monochrome.

For example: the eye easily distinguishes the visual difference or relative brightness of red, yellow and black; yet the ordinary, uncorrected photographic plate renders them all alike, without difference of shade or luminosity; similarly, yellow is visually much lighter or brighter than blue, but the photographic plate renders them in just the reverse order as far as visual brightness is concerned, the blue photographing very light and the yellow dark in tone or black. In many of the commercial photographer's subjects, this untruthful rendering of the colors in the subject spells failure.

The Means

The remedy is found in modern orthochromatic methods, which mean simply an intelligent use of plates especially prepared so as to be sensitive to (or capable of recording properly) the colors which predominate in the class of work in hand at the time, and color filters or screens which will supplemen tor control the color-sensitive plate used. In order to get correct color rendering, it is essential that both plates and screens be used, and that the screen be carefully adjusted as to its color-separation capacity with the plate employed. By this use of color sensitive plates of different capacities, and color filters of different capacities, the rendering of color combinations can be varied and controlled at will.

Helps

The choice and use of color-sensitive plates and filters involves much knowledge and experience. The reader who is practically acquainted with orthochromatic photography (about which several monographs have been published in this series) will have larger success in their use than the man to whom this field of work is unknown. But the makers of these color-sensitive plates, notably the Eastman Kodak Company and the G. Cramer Dry Plate Co. in this country, maintain departments in charge of experts, whose helpful services are freely placed at the disposal of photographers who have to meet the difficult problems of photographing colored objects. This service is all the more valuable when it is remembered that, in photographing any specific subject, such as furniture, paintings, fabrics, wallpapers, and so on, general information is of little help compared with the knowledge that the use of this or that plate and filter will really give the results desired.

For this reason I will not here attempt to explain the big questions of light and color, since these are fully discussed in manuals on color or orthochromatic photography. A brief discussion of the everyday use of color sensitive plates and filters may, however, be of service to the reader, as indicating the lines along which he should study and experiment.

Practical Suggestions

For some subjects and purposes, as when we photograph a landscape or house of neutral coloring out-of-doors, and it is desired to secure the sky and its white clouds in true relation to the foliage and greens in the composition, a plate sensitive to green and yellow is indicated, its abnormal sensitiveness to blue being retarded or held back by the use of a light or medium-yellow filter on the lens. The degree of contrast in the different color luminosities of the subject, as seen in the print, will vary according to the color depth or separation capacity of the color screen used. As all color filters cut down the actinic power of the light reaching the plate, the deeper the color of the filter used, the longer must the exposure be. Under exposure is the bugbear

of orthochromatic photography. Learn from the beginning to give an exposure at least one third longer than the subject indicates. For all subjects here indicated, where the color contrasts are not extreme and the lighting diffused, as where absolutely correct color rendering is not essential, ordinary orthochromatic or isochromatic plates are used, these being marketed under many trade names.

Paintings

If, on the other hand, we have to copy a painting, or photograph a subject where many different colors are in close juxtaposition, or where the color is pronounced in character, then the use of special plates is indicated, such as Panchromatic or Spectrum, which are sensitive to all colors. Here the choice of a properly adjusted color screen, chosen for the plate and the subject is a vital matter to successful results. A deep yellow filter is usually necessary with such plates.

Copying Blue-Prints

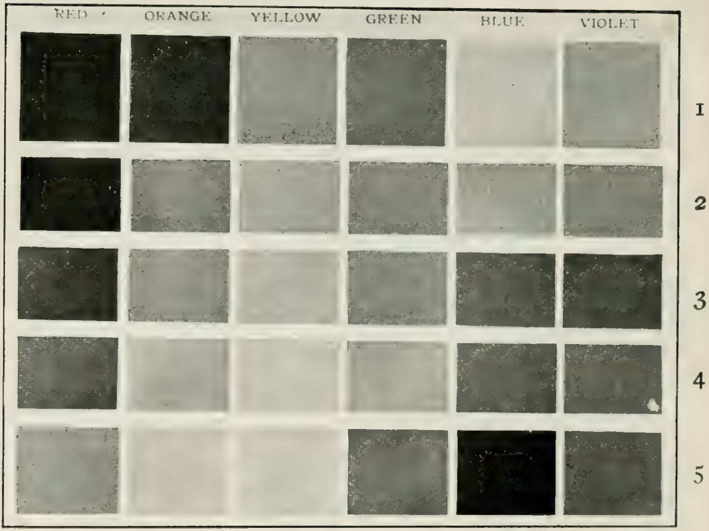
If the object to be copied is a blue-print, which with an ordinary plate would "take" all light, as the contrast is merely white lines on a blue ground, use a deep yellow filter, and the blue background will be held back while the white lines are building up in proper (visual) contrast in development. A Panchromatic plate and red filter is also advised as giving perfect results in this class of work.

Furniture

When photographing mahogany furniture, where the contrasts are yellowish red and brownish black, or walnut furniture, where the contrasts are yellow and black in varying depths of tone, a color-sensitive plate and a red filter will give satisfactory results. Exposures in such cases, of course, are prolonged. Oak furniture responds nicely to an isochromatic plate and medium yellow filter. For almost all these special subjects a safe rule is to use Panchromatic plates and a filter really adjusted to the plate for the subject in hand. The necessary information as to the proper filter to use in any particular work is best obtained from the maker of the plates used. He knows; we can only guess or experiment, which may be an expensive way of learning.

Demonstration Chart

The accompanying chart shows the effect when ordinary unscreened and color-sensitive plates with color filters are used. It may serve for the purpose of rough comparison. The first line of squares shows how an ordinary, unscreened plate renders the visual luminosities of the colors named. Using a Panchromatic plate and a



light yellow filter, we get the rendering shown in line No. 2. By using a medium yellow filter, the blue is still further held back and we get the luminosity contrasts shown in line No. 3. A deep yellow or light red filter lets the yellow and orange come through as lighter than green or blue (which they are visually), while the red is perceptibly lighter in tone, as seen in line No. 4. The use of a deep red filter still further accentuates this, as seen in line No. 5, but such a filter will rarely be needed, save in photographing such subjects as a fine book binding, or wall hanging with black lettering

or design on a deep red ground. Rooms or furniture where red draperies are included need this combination.

Position of Filter

The filter can be used either in front of or behind the lens, the ideal position being within the front of the lens tube immediately before the front element of the lens. Whatever its position, it must be placed at exactly right angles to the axis of the lens, and all the light reaching the plate must pass through the filter. If a film filter, instead of a cemented glass filter, is used, this may be placed between the lenses, but this cannot be done with any "air-space" lenses. A filter fitted into a lens cap slipping snugly over the front of the lens is very convenient. In development, remember that all color-sensitive plates should be handled and developed in darkness, unless we have a known and certain safe light for the plates in use at hand.

Finis

Let me repeat, in conclusion, that a practical knowledge of the use of color-sensitive plates and filters, and of the possibilities of modern orthochromatic methods, opens up so many profitable opportunities of business that the commercial photographer should lose no time or chance of acquiring this specialized knowledge. By means of it he can put his work on a higher plane than that occupied by the majority, who are content with the old-fashioned and imperfect methods of ten years ago, and so secure better prices, avoiding cheap competition. I recall the instance of a man in a large city, practically unknown, who was called upon to copy an old document, much faded and practically unreadable, which was required as evidence in a lawsuit settling a large estate. He copied it so successfully that its faint pencil marks, corrections and erasures were made perfectly legible, using deep yellow, red and green filters with color-sensitive plates in his work. His success brought him an amount of advertising and publicity which money could not have purchased, and from that time forward his business quickly increased beyond all his hopes. There are innumerable opportunities for special skill of this sort in commercial photography for the man who has the skill and knowledge. For such

workers competition does not exist; they are experts or specialists in the best sense of the term. Work comes to them in place of having to be sought, and they dictate their own prices.

GEORGE W. HANCE.

BOOKS

The following books and pamphlets will be found helpful to the commercial worker if he can lay hands upon them. Unfortunately they are, almost without exception, out of print with their publishers, but may possibly be seen at some public libraries or obtained by diligent search among dealers who may have odd copies.

Commercial Photography of Today. By George W. Hance. 101 pp. illustrated. Cloth $1.50. Published 1914. A few copies are obtainable from L. Black Co., Detroit, Mich.

Commercial Photography (The Photo-Miniature: Nos. 48 and 110). Published 1903 and 1910; illustrated. 25 cts. each.

Architectural Photography (The Photo-Miniature: No. 55). Illustrated. Published 1903. 25 cents.

Orthochromatic Photography (The Photo-Miniature: Nos. 6, 38, 45, 92). Illustrated. 25 cents each.

Photographing Flowers and Trees and Decorative Photography. Illustrated. 50 cents. (This is still obtainable.)

Photographing Interiors (The Photo-Miniature: No. 30). Illustrated. 25 cents.

Photographing Animals (The Photo-Miniature: No. 39). Illustrated. 25 cents.

Copying Methods (The Photo-Miniature: No. 41). Illustrated. 25 cents.

Photography in Advertising (The Photo-Miniature: No. 63). Illustrated. 25 cents.

Photography for Profit (The Photo-Miniature: No. 72). Illustrated. 25 cents.

Photographing Outdoor Sports (The Photo-Miniature: No. 91). Illustrated. 25 cents.

Marketing Photographs for Publication (The Photo-Miniature: No. 120). Illustrated. 25 cents.

Photography for the Press (The Photo-Miniature: No. 124). Illustrated. 25 cents.

Profitable Processes (The Photo-Miniature: No. 142). 25 cents.

Photographing Furniture; *Photographing Paintings*. Illustrated. Published by Kodak Ltd., London.

Orthochromatic Filters, illustrated, 1911, and *Real Orthochromatism* (a very valuable pamphlet on its subject), 1910. Kodak Ltd. (Wratten & Wainwright), London.

The Photography of Colored Objects. By C. E. Kenneth Mees, illustrated. 77 pages. 1909. Kodak Ltd., London.

Notes and Comment

My correspondence tells me that there is a persistent and increasing curiosity about stereoscopic photography among the better class of amateurs. I am glad to note this, as there can be no manner of doubt but that the most perfect form of monochrome photography is found in the stereoscopic transparency, when properly viewed. As to stereoscopic cameras at present available, I find in the new Folmer & Schwing catalogue the Stereo Auto Graflex and the Stereoscopic Graphic with Auto Graflex Shutter. The Goerz American Optical Co. also offer a Stereo Pocket Tenax, for plates or filmpacks, $1\frac{3}{4}$ x $4\frac{3}{16}$ inches. Unless I am mistaken, these are the only stereoscopic cameras at present available.

There is a world of satisfaction in a thoroughly reliable tripod when working away from home with any camera larger than $3\frac{1}{4}$ x $4\frac{1}{4}$. The difficulties are always bulk and weight. In commercial work these difficulties must not be allowed to interfere with the one thing necessary, viz: getting results. For this kind of work, the Folmer & Schwing collapsible tripod stand combines compactness, rigidity and lack of weight. It has a felt-covered tilting top which revolves or may be tilted to any position. It may be extended within a range of 33 inches from the floor to 47 inches above.

An example of the average "sports" subject where the advantages of reflex camera and focal-plane shutter are obvious. Made with a Graflex

Swanston Cottage, Edinburgh: Home of R. L. Stevenson

From negative made over a hedge with reflex held upside down at arm's length above the head

The John Knox Tablet: Edinburgh
Made with reflex pointed down toward the pavement

Spring Cleaning

An example of arrangement of picture by rapid glance into hood when using reflex camera at close quarters unknown to the subject

An Ancient Bavarian Stronghold
An example of placing the subject on the plate when the front is raised to full extent

Inside the Castle Gate, Rothenburg, Bavaria

The reproduction shows the reflex negative up to the edges of the plate, the black border being due to the rebate of the plate holder. Example of the nicety of focusing with objects near to and remote from the camera, at an aperture large enough to give full exposure to dark foreground at shutter speed required for moving objects.

A Medieval Market Place

Showing the advantage of the reflex with rising front. A difference of an inch in the position of the lens would have prevented the outline of the Neptune figure being obtained (as here) against the clear sky.

The New Inn: Gloucester
An example of $\frac{1}{10}$ second exposure with reflex

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Reflex Camera and Focal-Plane Photography

We photographers, rich and poor, beginners and experts, amateurs and professionals alike, are at bottom animated and controlled by the common desire to get the record wanted, whether pictorial or merely technical in character, and whether for pleasure or wholly a matter of business, in the simplest and surest way. Many of us, perforce, have had to find this simplest and surest way to success by traveling to the bitter end of the hard road of personal experience. The annals of photography abound with the strange adventures of the pioneers who blazed the way, and we wonder at their patience and persistence in the face of difficulties beyond our courage. The photographer of today, however, is twice blessed in this, that he has THE PHOTO-MINIATURE to tell him of short cuts along this weary way of experience, and the ripe fruit of the experience of those who have gone before him along that way, in the shape of apparatus cunningly devised and perfected for his helping toward success in the making of good photographs.

This number of THE PHOTO-MINIATURE is, in a very special way, published for those who have eyes to see and ears to hear of this simplest and surest way to success in photography. For it is wholly devoted to the handling of that type of camera which is fitted with a reflecting mirror and a focal-plane exposure shutter

which, in a word, is the beginning of the simplest and surest way we seek.

In all photography we have three controlling factors: the finding of the subject, by which is meant getting the subject properly placed on the focusing-screen or finder so that we will get in the negative what the eye sees and desires to record in the subject; focusing the picture image so that it will be agreeably defined, i. e. sharp all over, or modulated in definition by planes or other local emphasis as may be desired, and, finally, the delicate question of exposure. Passing for a moment to hand-camera photography, such as most of us know familiarly, these three all-important factors are seen to be so largely controlled by limitations in apparatus that success is to be attained only by special skill and some experience. The finder is so small that we have many disappointments in failing to find in the negative what we surely saw in the tiny finder. And the right use of such a finder taxes the skill even of an expert. Similarly, in focusing, we are dependent on the use of a tiny scale, to be used with an accurate knowledge of the lens rules on which it is constructed, and the ability to judge distances correctly which comes only from long and severe training. Finally, in the detail of exposure, wherein long experience tells that the surest guide and calculator is the appearance of the picture image on the focusing-screen, we have no focusing-screen and depend on tables and guesses and factors without number, perplexingly related to a lens-shutter speed of which we know only this one thing with certainty, viz., that it is uncertain, unreliable, and variable.

In this brief foreword I have no desire or intention to belittle the ordinary hand-camera. It is, in truth, a wonderful instrument. But its limitations in helping us to control the vital factors of successful negative-making cannot be gainsaid, and have much to do with the discouraging percentage of failures which fall to the lot of the average amateur.

I have said that the reflex camera and its focal-plane shutter is the beginning of the simplest and surest way to success in photography because it eliminates the difficulties inherent to the ordinary hand-camera, and

provides us with perfect means of controlling the three vital factors mentioned in the preceding paragraph. Thus the reflex provides a focusing-screen, showing the picture, full size, right way up. With this we can always be certain (1) that the subject we desire will actually be in the negative; (2) that the focus of the picture image is just what we want and is adjustable up to the actual moment of exposure; and (3) we can judge of the exposure needed by learning to estimate the light value of the illumination of the subject on the focusing-screen —as all professionals do. In the focal-plane shutter, as we will see later, we have two desirable helps not found in ordinary hand-camera shutter equipments, viz.: (1) the ability to give the plate or film a maximum amount of light during a given period of time, briefly expressed as light efficiency, and (2) the ability to give exposures sufficiently short to get well-defined images of rapidly moving objects without blur or indication of movement in the resulting picture.

These things being indisputable, it follows that the simplest and surest way to success in photography is to start with a reflex focal-plane camera and learn how to use it. To help the reader to know and use his reflex focal-plane camera intelligently is the purpose of this monograph. It is written by an enthusiast who knows whereof he speaks, and who has already given us practical proof of his right to speak about his hobby in THE PHOTO-MINIATURE, No. 99: *Reflex Cameras*, published in 1909. Since that time the reflex focal-plane camera has grown in popularity and is today readily obtainable in a variety of sizes and models under many trade names.

Let it be noted here, in the beginning, that the writer of this monograph rightly views and deals with the reflex focal-plane camera as the simplest and surest means of making good photographs of all subjects and upon all occasions (with perhaps the single exception of studio portraiture), and has no sympathy with the commonly prevailing but erroneous notion that this sort of camera is intended only for speed work and press photography. This point of view must be properly appreciated by the reader, otherwise he may be dis-

appointed in finding so much said about everyday work, and so little concerning the photographing of outdoor sports and subjects involving rapid movement. As was clearly pointed out in THE PHOTO-MINIATURE No. 77: *Focal-Plane Photography*, published as long ago as 1907: Focal-plane photography means chiefly a new interest in photography because of the wider possibilities it offers—the lengthening of the photographic day and season, the capacity for successful work earlier in the morning and later in the evening; for dull days and wet days in the early spring and late autumn; for home portraiture, sports, and like subjects of all kinds where the vital thing is maximum light efficiency at the plate or film during the all-too-short exposure necessitated by the subject or the time of photographing. Which wider possibilities are opened up by the simplicity and certainty and efficiency embodied in the reflex focal-plane camera in a larger degree than in any other type of camera available today.—
EDITOR.

What is a Reflex Camera? The reflex is a different kind of camera fitted with a shutter that is different. The two are used in conjunction. Both require knowing if the many special advantages of the combination are to be realized in full. Let it be understood at the outset that the reflex is just as much a camera for the beginner as for the expert photographer who is after the most difficult subjects. In fact a pre-eminent feature of it is that it cuts away at one stroke the two causes of half the failures in the use of a hand-camera, namely wrong focusing and faulty placing of the picture. More than this, it affords special facilities for getting results of quality; of getting them with surprising certainty and in circumstances unfavorable to the use of other kinds of camera.

Its Principles First a word on the principle of the reflex. Instead of a separate small finder showing a miniature picture of the scene, such as is fitted to the ordinary hand-camera, the actual image to be cast by the lens on the plate is seen, full-size and the right way up, upon a focusing-

screen placed in the top of this type of camera. This is done by means of a mirror fitted diagonally in the camera. The rays from the lens are reflected upward from the mirror on to the ground-glass, where the picture can be focused just as though it were formed direct without a mirror at all as in an ordinary view-camera. Meanwhile the plate or film is waiting ready for exposure at the end of the camera, facing the lens but covered by the opaque blind or curtain of the focal-plane shutter, and further shielded by the mirror. For exposure, pressure on a stud or trigger first causes the mirror to swing up into a position underneath the focusing-screen and excluding all light from the camera except that which comes through the lens. Immediately following, the blind of the shutter moves rapidly across the plate, and exposes it for a longer or shorter time according to its speed and the width of an aperture or slit in it. My reader will see at once that a reflex combines the certainty of a view-camera in focusing and choosing the subject on the screen with the speed in operation of any hand-camera.

The Exposure Shutter

The shutter takes its name from the fact that it moves in a surface or plane close to where the picture is brought to a focus on the plate, i. e., the focal-plane. Several advantages attach to a shutter of this kind as distinguished from those working in or on the lens. Exposures can be made very short—of the order of one one-thousandth of a second—by making the blind move very rapidly and having the slit narrow. Also the proportion of the time of exposure during which the plate is fully exposed to the image-bearing rays from the lens is greater than it is with most lens-shutters. This greater "efficiency," as, we shall see later, does in fact vary, but in a large proportion of focal-plane exposures it is greater than with lens-shutters. A third advantage, and one particularly applicable to a reflex camera, is that different lenses of varying focal length and capacity can be used without any trouble, a very big advantage at times. The reflex also offers convenient facilities for the use of color screens when required.

Advantages So much for the bare outlines of shutter and camera. Let me now turn for a moment to the advantages of a reflex in practical work. The chief of these is the full-size picture seen on the focusing-screen, and seen there infinitely more comfortably than is the image in a view-camera under the focusing-cloth or in the small finder of the ordinary hand-camera. Leaving color out of account, the picture shows exactly what the finished photograph will be like, except that on the ground-glass it is reversed, the right-hand part of the subject on the left and *vice versa*. Next is the facility of focusing the subject or any particular part of it with absolute certainty. With many hand-cameras this is a matter of skill and judgment in the use of a focusing-scale, calling for much practice, and by many people never acquired at all with any approach to certainty or infallibility. With the reflex you do not judge or guess: you see, and the person who has never handled a camera before is almost as certain of sharp negatives as the old hand, accustomed to use an ordinary kind of snapshot camera every day of his life. Further, the reflex is an all-purpose camera, serving efficiently for all kinds of subjects, with the solitary exception of those where a wide angle of view is required. The latter is a facility which is not embodied in a reflex instrument, since the space which must necessarily be provided for the moving mirror does not allow of the use of a lens of short focus in relation to the plate. And last, the reflex is a camera which, like a high-grade automobile, is cheap to run, i. e. economical in operation. The proportion of spoiled material is cut down to a minimum by its accuracy in the ways already mentioned, and its construction renders impossible such minor wastage as results from making an exposure with the lens covered or stopped down, mistakes which most of us make at times with an ordinary hand-camera.

—and Drawbacks On the other side of the balance-sheet are certain features which will rank as drawbacks largely according to one's circumstances. These are bulk, weight, cost, and conspicuousness. A reflex of box pattern and quarter-

plate size ($3\frac{1}{4} \times 4\frac{1}{4}$) measures roughly 6 x 6 x 6 inches; a 4 x 5, about 7 x 6 x 7, and a 5 x 7, about 9 x 8 x 9 inches. The weights will run about 4, 5, and 8 pounds, respectively, and the cost \$50 (£10) to \$100 (£20) in the case of a medium-priced instrument. The more conspicuous action entailed by looking into the hood of a reflex is no drawback at all in perhaps 90 per cent of average work: it is a disadvantage chiefly when one is seeking to get figure studies unknown to the subjects, though here, as we shall see, there are ways and means of using the camera adroitly so as to conceal its purpose.

Depth

Before coming to the features which are desirable in an efficient reflex camera, let me say a word on the "depth of focus," more properly termed "depth of field," which lies at the back of all hand-camera work. Briefly, the larger the actual diaphragm or "stop" in a lens (regardless of focal length) the lower the capacity of the lens to render near and distant objects in focus at the same time. Hence a lens requires to be of quite short focus or, if of long focus, to be used with a comparatively small stop in order to get everything further than, say, 4 yards from the camera into sharp focus. For example, with the focus set on something 4 yards away, a 4-inch lens can be used at $f/5.6$ and everything up to extreme distance be obtained sharp, whilst an 8-inch lens under the same conditions will require stopping down to $f/22$. In other words, the bigger we make the diaphragm, either by using a high-speed lens or one of long focus, the lower the power to get near and distant parts of the subject sharp; which means that the combination of great depth and high speed of lens limits us to a lens of short focus, in actual practice to one of 3 or 4 inches. Now a reflex camera will not do anything whatever to increase the depth given by a lens of such and such an actual diameter of aperture. What it does do—and it is a most valuable property—is to show us exactly where the depth of field is operating. Thus it enables us to localize the field of definition in any desired part of the subject—which very often is all that the picture requires; or alternatively, causes us to see the necessity of using a smaller stop in order

to secure a greater depth of definition or sharpness throughout the picture. In other words, the reflex makes certain the use of a very shallow field of "depth," as when using a large-aperture lens of 6 or more inches focus or when photographing a very close object such as a bit of carving on a large scale. Anyone who has done any same-size copying knows that the slightest departure from the correct distance betwen lens and object is fatal to the sharpness of the image in the negative. It will not do to trust to judgment of distance in such cases, but with a reflex the exact focus can be got almost as certainly as with a table copying camera. In short, the reflex camera replaces by an instinctive act of focusing, as judged by the picture on the ground-glass, the elaborate tables of depth with various lenses and apertures and for various distances from the camera which are drawn up for guidance in hand-camera work but are at the best a cumbrous help.

What Size of Camera?

Coming now to the choice of a reflex, the first thing, I think, is to settle in one's mind what size one shall adopt. Bulk even more than weight is the chief drawback to a reflex and it must be realized that the 4 x 5 size or anything larger adds a separate piece of baggage to one's holiday belongings or equipment. None of these larger cameras are things which can be put into a suitcase or kit-bag, when one is going away for a day or two, on the chance of subjects turning up, and even the 3¼ x 4¼ will often prove a nuisance if one's outfit is small. Moreover, any reflex larger even than 3¼ x 4¼ with a supply of plates or film becomes something of a load in the course of a day on foot. To classify the sizes roughly, I would say that the 2½ x 3½ (or 2¼ x 3¼) and 3¼ x 4¼ are the only two for the man or woman who intends to carry the camera as he or she would a folding Kodak. The 4 x 5 and 5 x 7 are for those—press photographers, automobilists and the like—who have to bear the burden of the apparatus only every now and then, whilst the postcard (3½ x 5½) reflex, if of a certain pattern, forms a compromise which, if its limitations are recognized, may be adopted by either of the two classes of reflex workers mentioned.

Which Small Size? Of the two sizes, $2\frac{1}{2} \times 3\frac{1}{2}$ or $3\frac{1}{4} \times 4\frac{1}{4}$, my own preference—and I have used both—is for the smaller, and I will tell you why. Both give pictures which are not of much use without enlargement except as mementos in albums, and for that the smaller size is pretty nearly as good as the larger. In enlargement, owing to the greater depth of focus, the 2 x 3 negative will give as good an account of itself, up to, say, 9 x 12 inches, as the 3 x 4. Moreover, the smaller negatives are just the right size for stereopticon slides by contact, whilst the larger are about an inch too large and compel one to go to the trouble of making diapositives by reduction in order to get the whole of the subjects which, with a reflex, it is so easy to place "just right" in the full space of the plate. These points perhaps would not decide my choice if they stood by themselves, but they are further strengthened by a saving in cost of plates or film of over 30 per cent, and finally the balance in favor of the smaller is toppled down by the lesser bulk of the camera. A quarter-plate box reflex, if of the revolving-back pattern, has got to be taken by itself if one is going for a trip, but the $2\frac{1}{4} \times 3\frac{1}{4}$ or $2\frac{1}{2} \times 3\frac{1}{2}$ is just compact enough usually to pack with other things in one's baggage without inconvenience.

Pattern The choice of size is, however, dependent to some extent on the build of the camera. Reflex cameras are some of them built oblong—that is to take a picture only "landscape way" of the plate—whilst others are made square, with a square focusing-screen in the top and a revolving back by which the plate-holders can be quickly turned into the upright or horizontal position whichever form the subject is desired to have. The square pattern is of course one which more completely fulfils practical requirements but it is necessarily more bulky than the other. For example, the $3\frac{1}{4} \times 4\frac{1}{4}$ square revolving-back pattern of the Auto-Graflex measures $8\frac{3}{4} \times 5\frac{1}{2} \times 7\frac{1}{2}$ as compared with $5\frac{3}{4} \times 5\frac{3}{8} \times 6\frac{1}{4}$ for the ordinary Graflex taking the same size of picture. Look at these figures again. While the majority of outdoor subjects take the horizontal form, the ad-

vantage of placing the plate vertical when a figure study or similar subject requires it, hardly needs to be pointed out. With the ordinary pattern an upright picture can be taken only by holding the camera on its side. It is then still possible, though not at all convenient, to see and focus the picture, by the aid, if it can be so called, of the sideway projecting hood. If the best treatment of all kinds of subjects is a consideration, the square pattern is fully worth its extra cost and larger size. The long narrow postcard size of picture is about the only one which does not call for a vertical position, and this size and pattern of reflex is therefore one which is very suitable for outdoor screens and similar subjects, whilst of comparatively slim dimensions.

The Mirror

The next point in regard to which reflexes differ is the mirror. In the better patterns, the mirror is actuated by a spring so that, the moment you press the shutter-release, the mirror automatically swings into the up position and is held there by the spring, the shutter immediately coming into operation. In other patterns the mirror is raised by pressure of the finger on a lever placed outside the camera. When it has thus been pressed up, the last bit of thrust on the lever releases the shutter and, on removing pressure from the lever, the mirror falls again. There are things to be said for both of these movements, but the better of the two is unquestionably the raising of the mirror by a spring for the following reasons: The operation of the camera in making an exposure is smoother; the mechanical work is done by the spring and is not subject to jerk or jar as it is liable to be when by hand. Also the spring-action is more regular than that of the hand in determining the interval between pressure on the release and the exposure of the plate. This interval depends only on the spring, whereas with the hand-raised mirror it depends on the vigor with which the lever is pressed down. Also the hand-raised self-falling mirror is free to move and flop about when the camera is pointed downward, requiring a separate locking device if it is to be used in this way and, last, the camera cannot be held upside down over the head for the purpose of

photographing over obstacles, a method which, as we shall see, is sometimes of real practical value. Altogether the spring-raised pattern is the better and is that adopted by makers of the more expensive cameras. The advantages claimed for the self-falling mirror are more imaginary than real.

Shutter and Mirror

There is another point with reference to the mirror which must be mentioned. In some few cameras the shutter cannot be re-wound after an exposure whilst the mirror is still up. With such models you have to put the mirror down and so cover the unprotected film or plate before you can wind the shutter. Personally I like this arrangement, because it is an automatic preventive of accidental fogging of the sensitive film through careless re-setting of the shutter before the mirror has been put down. It is, however, a useless movement if the shutter is of the "self-capping" type, that is one which presents a slit when it runs down but forms an unbroken curtain when it is re-wound. Even if the shutter is not of this type, many reflex users prefer to forego the safety device, since by so doing they get the facility of using the shutter independently of the mirror. This is certainly an advantage, especially when one has to use the reflex on a tripod or some other support where it is very awkward to look down into the hood for focusing. In these circumstances, the picture can be viewed and focused on a second screen (supplied with most reflector cameras), which fits into the place of the plate-holder and is removed in order to insert the latter, just as in the use of the ordinary type of camera. If one can't do this, exposures have to be given by means of both mirror and shutter and often call for some delicate maneuvering. It is largely a matter of personal preference which is the better system of the two.

Focusing-Screen

If the camera is of the square revolving-back pattern, the focusing-screen is also square or nearly so, and requires to be marked so as to show plainly the space and proportions of both the upright and horizontal pictures. I have used for years with entire satisfaction a screen marked in the way adopted by Newman and Guardia

(and possibly by other makers) for their cameras and consisting simply of an opaque square patch (black varnish) in each corner of the square screen. The side dimension of each corner patch is just half the difference between the long and short sides of the plate. For example on a quarter-plate screen, measuring, say, 4 x 4 inches, the corner squares are ½ x ½ inch. They very plainly indicate a 3 x 4 space on the screen upright or horizontal according as (in looking at the picture) one ignores the two side panels or the top and bottom panels which are formed by joining the inside corners of the squares by bold pencil lines. I would just as soon have this simple marking as the elaborate automatic masks which in some cameras are connected with the revolving back and move with it.

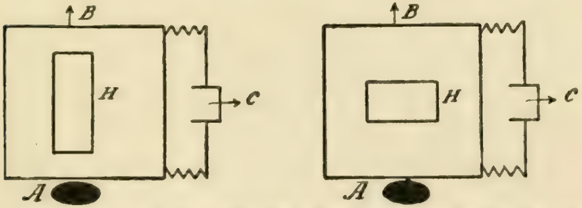
Usually the focusing-screen is fitted in the camera glass side up, in which position it will often make viewing and focusing difficult if the hood fits the head badly and lets stray light in on to the reflecting glass surface. Some workers find themselves bothered by the reflection of their eyes which they see in these conditions. They can remove the defect by having the screen placed ground side up, the rabbet in which it rests being lowered by the thickness of the glass. The only objection to this is that the ground side holds dust and dirt more than the polished surface and a dirty screen is inimical to easy focusing. And this brings me to a very vital practical feature of a reflex.

The Hood Anybody with no experience of a reflex will appreciate the necessity of a hood which affords a clear and comfortable view of all but the extreme corners of the picture. The clear view is a matter of the shape of the hood when erected; the comfort largely depends on the height, which should be from 7 to 8 inches. But a necessary feature of the hood which perhaps will not be anticipated is that it should be quickly turned back so that the whole screen can be dusted or wiped. It is more important to be able to do this quickly than it is to get at the mirror readily. In the course of a day's work the screen will get dusty or may become spotted with rain drops. Either makes sharp focusing almost

impossible, and therefore I put a hinged or otherwise semi-detachable hood as a very important feature. Very short-sighted people, who find a difficulty in focusing from the distance of the mouth of the hood, can have the latter fitted with a suitable pair of glasses. In Britain this fitment is supplied by the firm of Marion so that it folds flat against the inside of the hood, remains there when the hood is closed, but is instantly sprung into place for use when the hood is extended.

Reversible Hood

Another pattern of hood has been introduced of late years on European reflex cameras. It is one of the ordinary shape but attached to a loose square frame which can be clipped into position above the screen either way, that is with the oblong mouth of the hood either across the camera (the usual practice) or lengthways with it. The object of this second position is to enable the user to make a feint of photographing in a given direction when



FIGS. 1 and 2. Illustrating use of reversible hood. When the photographer stands looking in direction *B*, but with lens pointing in direction *C*, it is difficult to focus with hood *H* in ordinary position (Fig. 1); but easy with hood reversed as in Fig. 2. See also Fig. 5.

actually the lens is pointing in a direction at right angles. With a reversible hood it is easy to see and focus the real picture when one takes this side posture, but with a fixed hood it is very awkward to look with both eyes through the narrow dimension of the hood-mouth. The two plan-diagrams (Figs. 1 and 2) will make this clear. The reversible hood is quite a useful feature in figure-study work or whenever one wants to photograph without the subject's attention being prominently called to the fact, as at public meetings out-of-doors and street photography.

Focusing-Pinion and Shutter-Release

A further matter of some importance in choosing a reflex is the position of the milled focusing-pinion head and the shutter-release, whether these should be on one side of the camera or on opposite sides. It may seem at first that the latter is the better plan, on the ground that one can focus a moving subject with one hand and keep the other in readiness to actuate the shutter. As a matter of fact it is almost a practical impossibility to work in that way. In actual practice you focus on some determined spot and then wait until your subject gets there. You will never get sharpness with regular certainty by trying to keep track of a moving subject with the focusing-pinion. Hence no useful purpose is served in having the two adjustments on opposite sides whilst there are positive advantages in having them on the same side: The camera can then be grasped more firmly by the one unoccupied hand. Also one side of the camera is usually free from projections when this arrangement is adopted and can be laid flat and firmly on one side. This is a facility which is often of service in taking a view from the top of a wall or fence. With the camera on its base you cannot get high enough to look down into the hood, but by laying it on one flat side you can look horizontally into the hood and have the release and focusing-head convenient to the hand on the upper side.

Other Movements

The foregoing end my list of movements peculiar to a reflex, but the latter, like any other high-grade hand-camera, is all the better for ample provision in the way of rising or swing front or extension. All the more so, since with a reflex the effect of these movements is seen on the screen as the adjustment is made, and is not merely guessed at as with most hand-cameras, in using which one has to trust to finders. An ample amount of rise of lens is one-third the height of the plate; one-quarter is pretty good but many reflexes permit only one-eighth and some none at all. Adjustment of the moving front by screw or rack and pinion is a great boon.

Few reflector cameras are fitted with a swing front for the lens, although this is a most valuable movement,

particularly for high-speed workers who can employ it for securing depth of focus without sacrificing the full speed of a large-aperture lens. Apart from this, its absence will not be felt.

Extension

Inspection of the makers' catalogues will show that the maximum distance obtainable between lens and plates varies, in different cameras, from about 7 to 15 inches in the $3\frac{1}{4} \times 4\frac{1}{4}$ size: other sizes in similar proportion. A good many cameras permit about 9 or 10 inches. The question arises: Is a fairly long extension, say 12 inches for a quarter-plate, a really important feature in an all-purpose camera, or can it be dispensed with and a less costly, lighter, and more compact instrument chosen? My reply is that modern improvements in lenses have largely removed the necessity for double-extension capacity in the reflex. The object of the long extension is twofold: To use a long-focus lens and to use, on occasion, a short-focus lens for copying small objects somewhere about same size, that is with a camera extension of twice the focus. The first of these purposes is fulfilled at normal single extensions by the newer fixed-focus large-aperture telephoto lenses such as the Dallmeyer "Adon" and the Ross "Telecentric" working at $f/5.6$, yielding the crisp definition of an anastigmat, and requiring a camera extension of half or less than half their real focal length. The copying, which usually will be a very small proportion of the average worker's exposures, can be done either with the usual lens provided with an extension tube or box, or with an extra short-focus lens of focus rather less than half the maximum camera extension. For example, a little 4-inch anastigmat of $f/4.5$ or $f/5.6$ aperture serves excellently for this copying work on a quarter-plate. At extension for a same-size copy it will work at $f/9$ or $f/11$ and will cover the plate quite as well as subjects like flowers, rock specimens, living insects, etc., require. Naturally, a 5- or 6-inch lens would be better since it allows of greater distance between the subject and the lens and therefore gives better drawing. In fact, especially for the photography of such subjects, one would get a reflex of the longest extension obtainable;

but in view of their infrequency there is no real inducement to choose a double-extension reflex camera when this and the long-focus work can be done with the more compact single-extension pattern.

Focal-Plane Shutters

We have briefly noted the focal-plane shutter as an opaque blind, with a slit in it, which moves close in front of the plate, or, as usually expressed, in or near the focal plane of the lens. Now we must learn a little more about it. The speed of the shutter is determined (1) by the width of the slit and (2) the speed at which the blind moves, which, of course, is determined by the tension of the actuating spring. Both of these adjustments have been used in providing a range of speeds, but of late years some makers have inclined toward avoiding continual changes in the tension of the spring on the reasonable ground that they alter the spring's pulling powers. Thus they have sought to work with the spring always at one tension, or to vary the tension as little as possible and to obtain the range of speeds by different widths of slit. Given a constant tension, the effect of width of slit on the time of exposure is a matter more or less amenable to calculation, whereas the effect of different tensions is not. Thus several modern focal-plane shutters are designed to yield speeds from say one-tenth to one-one-thousandth of a second by the conjunction of one spring-tension with an adjustable slit, whereas others employ a series of spring-tensions with a blind containing slits of different and fixed widths. The N. & G. shutter is of the first pattern; the Graflex is of the second type. The blind of the latter has five slits of widths such that the exposure with the widest is about thirty times that with the narrowest. Thus with the spring at a medium degree of tension the range of actual speeds runs from, say, one-twenty-fifth to one-six-hundred-eightieth and there is not much necessity to alter the tension frequently. The tension may be high or low but, as will be seen directly, it is always better to work at a high tension and with a wide slit than with a low tension and a narrow slit. Better, that is, as regards the maximum light-action on the plate: mechanically the reverse is the case, a high

tension is more trying to the mechanism of the shutter and tends to variation in exposures.

Self-Capping Shutters These, as already mentioned in dealing with the camera, are designed to form a complete covering for the plate when the blind makes its return journey on re-winding after exposure. They are necessarily more complex than the ordinary type and, as the shutter of a reflex is about the only part of the apparatus which is liable to get out of order, it is good policy to choose the simpler pattern. In a reflex with a spring-raised mirror, which makes a light-tight joint with its seating when in the down position, there is very little advantage in having a self-capping shutter.

Efficiency Now I must come to a matter connected with the focal-plane shutter which some may perhaps be tempted to skip on sight of some formula or symbol suggestive of theory or mathematics, or some other thing which the good reader looks upon as pure folly. But I beg for a reading in order to show the reader, first, that the theory, like the curate's lie, is a very little one; and, second, that this question of efficiency has a great deal to do with the best use of a focal-plane shutter. The reason of this is that with lens-shutters you take the efficiency as the maker gives it to you and do the best you can with it, whereas with the focal-plane shutter you can make it greater or less according to the way you use the shutter.

What is "Efficiency?" Efficiency is not the easiest thing to explain in a few words. Take one example: If, during an exposure of, say, one-one-hundredth of a second with any shutter you like, the plate receives the full action of the lens for the whole of the period, we should say that the efficiency of the shutter is 100 per cent. But a shutter of this perfect efficiency does not exist, although the focal plane in some circumstances comes "as near as no matter" to it. With all lens-shutters some time is taken by the opening of the leaves or sectors of the shutter before the full aperture of the lens is uncovered and again some time in covering it again. Suppose that these two stages are such that the light-action upon the

plate is equivalent to only one-two-hundredth of a second with the full lens-aperture, the efficiency would be half or 50 per cent. If equivalent to one-one-hundred-fiftieth of a second, the efficiency would be two-thirds or 66 per cent. Understand that efficiency has nothing to do with the time during which the shutter remains open, that is to say, its sufficient speed to render moving objects without blur: efficiency, as here discussed, is the measure of the amount of effective light allowed to act on the plate during a given exposure, whether long or short.

Focal-Plane Efficiency

Now it has often been assumed that the focal-plane shutter, from its construction, must inevitably pass to the plate all the light which comes through the lens. On the face of it, when you think of a slit or opening moving in front of the plate, it seems impossible that it can be otherwise. But that view overlooks the optical rules which govern the production of the picture on the plate—rules from which there is no getting away. These rules would be without effect if the shutter worked really in the focal plane, that is in contact with the plate, but even with a film focal-plane camera, the curtain is an eighth of an inch in front of the sensitive surface: with plates you have to put the surface a little farther back, a distance of 3/8 to 1/2 inch according to the make of the camera. That is the root cause of the efficiency of the focal-plane shutter being much less than 100 per cent in certain conditions. Those conditions are the use of a very narrow aperture or slit in the curtain and of a large-aperture lens. Either reduces the efficiency but the greatest reduction is produced by the two in conjunction.

The Why of Efficiency

Look at the diagram on page 307. It represents actual and not uncommon conditions, viz., a 5-inch $f/4$ lens in conjunction with a shutter, the curtain of which moves in a plane half an inch in front of the plate. Calling the diameter of the diaphragm D, it will be understood that the image is made up of an infinite number of cones of rays, having D as their base and coming to a point on the sensitive surface. I have drawn two of

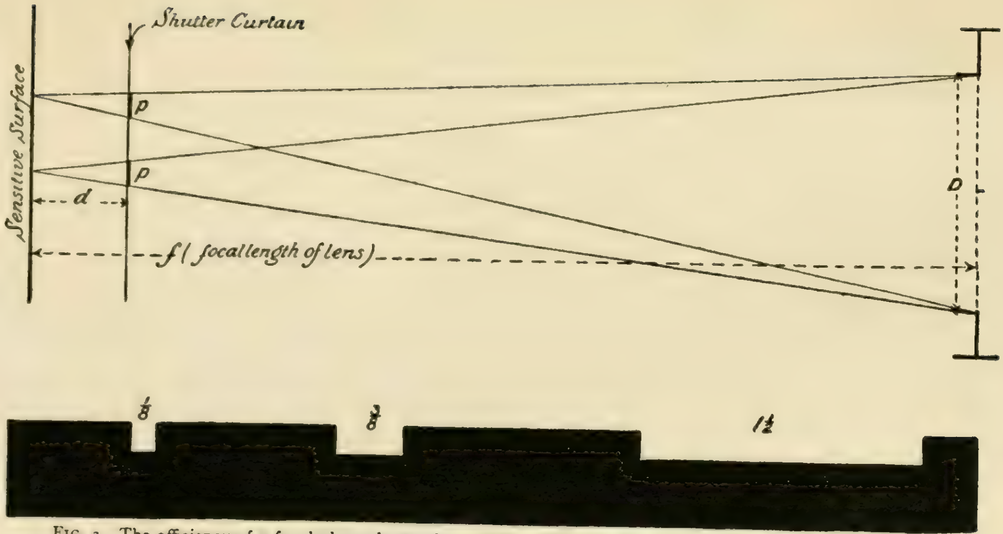


FIG. 3. The efficiency of a focal-plane shutter is conditioned by the width P of the pencil of rays from the lens diaphragm D in the plane of the curtain and by the width of the curtain aperture. A copy of the lower black strip can be made and used to show why this is so. See text page 306.

these, one exactly in the center of the field of the lens and the other a little away from it. You will notice that where these cones (as represented in section) meet the surface of the curtain, they are still of a certain, though small, width, in this case about one-eighth of an inch. Now try for yourself what is the effect of exposing the plates with a curtain-aperture of one-eighth inch width. With the diagram I have included a drawing to represent a blind with three apertures of ⅛, ⅜, and 1½ inches respectively. You can easily reproduce it with a piece of paper and a pair of scissors. Having done so, lay the notched edge of the paper on the line marked "shutter curtain" in the diagram and move it along that line until the narrowest notch just begins to uncover the short line *p* representing the width of the light-cone in the plane of the curtain. You will notice that you have to bring the notch, otherwise the curtain-aperture, right over *p* before *p* is fully uncovered and that the instant you move it further, the other edge of the notch begins to cut off *p*. In other words the full beam of rays is acting on this particular bit of film only for an infinitely short time: for almost all the time during which this particular bit of image is being formed on the plate only part of the beam is effective. And this is so for every other bit of the image and however fast or slow the curtain is moving.

Now try the two wider notches and you will see that they (the wider more than the narrower one) allow the beam of rays to exert its full action for a fairly long time in comparison with the time required for uncovering and covering it. In other words, the efficiency with the one-eighth-inch slit is low (actually only 50 per cent) whilst with the others it is much higher, viz., 75 per cent and 92 per cent.* This experiment, I hope,

*For the benefit of those who wish to know the basis of the above calculations, it may be pointed out that by simple geometry, the width *p* of the cone of rays is the curtain distance divided by the *f*/ number. This follows from the two triangles on the bases D and *p*. $D : p :: f : d$. Whence $p = \frac{Dd}{f}$. But the focal length (*f*) divided by the diameter of the stop (D) is the *f*/ number, so that $p = \frac{d}{F/No.}$

Further is it easy to establish a rule by which to calculate

will make it clear that reduced efficiency results first from a narrow curtain-aperture and second from a comparatively broad cone of rays in the plane of the curtain, the breadth of this cone being greater the further the curtain is from the plate and the larger the working aperture of the lens.

Efficiency Figures

By the method given in the footnote on this page it is easy to calculate the efficiency of the focal-plane shutter for various widths of curtain-aperture and distances of curtain from plate and when a lens of large and medium aperture is used. A few such figures are worth setting down since they tell their own tale. Here they are:

I. EFFICIENCIES (in percentages). F/4.5 LENS

CURTAIN DISTANCE FROM PLATE	WIDTH OF CURTAIN APERTURE		
	1/8 inch Per cent	3/8 inch Per cent	1 1/2 inches Per cent
1/8 inch	82	86	98
3/8 inch	60	82	95
1/2 inch	51	77	93

the efficiency of the shutter under any conditions. Remember that the efficiency is the imaginary (calculated) time (T_1) during which the cone of rays is fully operative divided by the time (T_2) during which the cone is operative to any extent at all. Assume that the curtain is moving at a certain speed t, signifying the time, t, required for it to traverse an inch or a foot—it doesn't matter what the unit is for our purpose. To find T_1, slide the notched strip along the line of the curtain and you will see that its passage over p falls into three sections, viz., one in which the length on which the full cone is operative, is $s-p$ and two others (at the beginning and end of its transit) in each of which the cone may be imagined as, first, completely covered and then just covered by a slit of width p. Each of these corresponds with the full action of a slit of $\frac{p}{2}$, so that adding these three sections together we have $(s-p+\frac{p}{2}+\frac{p}{2})\ t$ seconds as the time of the exposure during which the full cone is operative, in other words $s\ t$ seconds. Finding T_2 is simpler. Again if you run the notched strip over p you will see that it is uncovered (wholly or partially) over a length $s+p$. Hence the time T_2 is $(s+p)\ t$ seconds. And thus the efficiency or the ratio of T_1 to T_2 is $\frac{s}{s+p}$. This is a very simple formula and, although it may not be perfectly correct, since it assumes the blind to move at a quite uniform speed, it allows of figures for efficiency being usefully calculated.

II. Efficiencies (in percentages). F/8 Lens

Curtain Distance from Plate	Width of Curtain-Aperture ⅛ inch	⅜ inch	1½ inches
	Per cent	Per cent	Per cent
⅛ inch	90	96	99
⅜ inch	73	88	97
½ inch	67	86	96

The above figures apply to actual working conditions. In the roll-film Graflex the sensitive surface is ⅛ inch from the curtain: in the plate patterns, ⅜ inch. The curtain apertures here mentioned, ⅛, ⅜, and 1½ inches, are those of the Graflex.

Focal-Plane Maxims

The figures very clearly teach us several things, viz:

(1) With a curtain as close as ⅛ inch to the sensitive surface, it doesn't much matter how narrow an aperture or how rapid a lens you use: you will be certain of getting an efficiency at least over 80 per cent.

(2) With a fairly wide curtain-aperture—⅜ inch or over—it doesn't much matter what the curtain-distance or lens-aperture is: you will get efficiencies of from 99 per cent to about 80 per cent. Thus it is always better to get a given exposure by running a wider aperture faster than a narrower aperture slowly.

(3) It is when using the narrowest-aperture slit with a wider-aperture lens that the efficiency drops seriously. Under these conditions a small curtain-distance makes a great difference. These, of course, are the conditions for ultra-high-speed work, and it is here that the maker's skill in causing the shutter to approach the true focal plane is of chief importance.

Setting the Shutter

Before taking up the use of the focal-plane reflex in various branches of photographic work, I would just mention one point in regard to the shutter which may be overlooked by the intending purchaser of the camera. All makers dilate on the great range of speeds, but few of them say whether the speed can be altered whilst the shutter is set in readiness for an exposure; or, if it can, what kind of adjustment it is. But this is a distinctly important point in practice. Some shutters can have

the speed altered only after they have been released. With them it is a nuisance to have to cap the lens or insert the shutter of the plate-holder in order to make a change. With others, an alteration in the width of the slit cannot be made but the speed can be reduced or increased by altering the spring-tension, that is supposing the spring is at a medium tension. With others the speed can be put to any figure, with the shutter set, by turning a key. With the Graflex, for instance, any slit or tension can be brought into operation whilst the shutter remains set, and in addition successive exposures with all the slits from ⅛ inch to 1½ inches can be given without further manipulation of the shutter. In other words you can give exposures in succession of one-three-hundred-fiftieth, one-one-hundred-tenth, one-fortieth, and one-tenth (or other series according to the spring tension), by simply putting down the mirror each time. I don't know that there is any great advantage in being able to do this—it simply follows from the excellent multiple curtain of the Graflex—but a facile alteration of the speed whilst one is waiting to make an exposure is sometimes necessary in order to deal with developments in a moving subject and is always a convenience in making the requisite change of speed from subject to subject.

Using the Reflex

One may roughly divide reflex work into two classes, namely the photography of ordinary views, figure studies, and other subjects without any very rapid movement in them and, second, the photographing of sports of various kinds, automobiles etc., in which the subject is in rapid motion and often comparatively close to the camera. Subjects of this latter class call for refinements in the use of the camera which are quite unnecessary in dealing with the more ordinary scenes and people such as are recorded by the least-expensive hand-camera but are handled with immensely greater certainty by a reflex. I will first deal with the more ordinary subjects.

Keeping the Reflex Fit

While there is nothing in a well-made reflex which requires constant attention, there are one or two points to be looked to before taking the camera out. See that the mirror is

clean by dusting it with a very soft brush. A few specks of dust do not matter, but a layer of dust all over it will interfere with a bright and sharp picture on the focusing-screen. The latter also should be wiped clean with a handkerchief. If the camera has been kept for long in a cold place the shutter curtain may be a little stiff. Therefore see that it runs freely even at the longest exposures by letting it off a few times. If it doesn't, a few minutes in a moderately warm place will put it right for smooth action.

Holding the Camera

Like any other hand-camera, the reflex does not require to be clutched with convulsive tightness in order to hold it steady. In fact that is just the way to insure a little shake or tremor at the moment of exposure. Simply hold it firmly but without clenching or stiffening the muscles. I prefer to support it against the body with one hand, leaving the other fingers free, first for focusing and then for operating the shutter. The beginner is apt to clasp the camera so tightly that vibration is set up from the tension of the muscles. Hold the camera almost slack and then you will have no occasion to charge a costly instrument with giving a blurred negative.

Lens-Stop and Shutter-Speed

For general work a lens-aperture of $f/6$ is the most useful. If the focal length is anything over 5 inches, the depth of field with $f/4.5$ is not enough for all parts of the subject. A lens of this larger aperture is useful chiefly for figure studies, animals in zoos, and similar subjects where one wants to focus almost entirely on one spot and prefers the rest not to be equally sharp. And for such work a focal length from twice to three times the long side of the plate is a good choice, so long as the lens front is big enough to take it, as it enables one to get further away from the subject.

With $f/6$ a shutter-speed of one-fiftieth to one-twenty-fifth of a second with an extra-rapid plate (not the very fastest ultra-rapid) will be about right for full exposure of average subjects. Under such conditions it is easy to use a smaller stop if the shutter-speed is judged too slow, or to speed up the shutter if the movement in the

subject requires it. But the real one-fiftieth or one-hundredth second given by a good focal-plane shutter is ample for sharp rendering of moving objects like vehicles, people, animals which are not in rapid motion and, as is still more material, are being reproduced quite small in the picture. Thus the reader will see that for all such work a curtain aperture of at least ¾ inch can be used, a shutter-efficiency of about 90 per cent being thereby secured.

Shade the Lens

When using any lens, but most especially those of the more-complex construction employed to get an *f*/4.5 aperture, there is a great gain, as regards brilliancy of the negatives, in using the hinged shade provided on most box-pattern reflexes. But in adjusting the angle of the shade don't rely absolutely on the absence of a dark band across the upper part of the picture on the focusing-screen. Better to be content with a higher angle than risk obstructing the view by setting the shade too low. It is not easy to judge on the focusing-screen exactly when the shade has been lowered so as just not to obstruct the rays which form the picture, wherefore it is well to leave a margin.

Follow a System

The reflex being a camera with a number of movements, it is well to make it a rule, after each exposure, immediately to restore matters to some standard condition which each worker may adopt as normal. First put the mirror down, then re-set the shutter, and, if thought well, restore the lens to center, if it has been raised, and the revolving back to horizontal, if the less usual upright picture has been taken: also the lens-aperture to whatever F number be taken as standard. A little method applied in this way will obviate mistakes due to overlooking previous and forgotten adjustments of the apparatus.

Over Obstacles

One of the defects with which the reflex has been charged is that it is always necessary to hold it with the lens at about the waist-level, owing to the necessity of looking down the hood. It is only seldom that this is felt to be a drawback, but occasions do arise when one

wishes to photograph at the eye-level or from a still more elevated standpoint. There are, however, ways of getting over the difficulty. Take, for example, the case where one wants to avoid including a fence or wall in the picture by placing the camera on the top of it. It is then generally impossible to view the picture in the hood with the camera in the ordinary position,

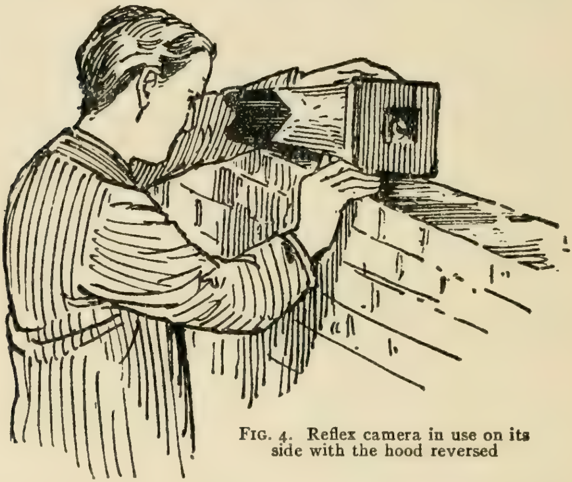


FIG. 4. Reflex camera in use on its side with the hood reversed

but you can lay or hold it on its side, with the hood horizontal, and can then look into the hood from a sideway position as shown in Fig. 4. It is in such circumstances as these that the reversible hood and the placing of focusing-head and shutter-release on the same side of the camera are a real convenience.

If the fence is still higher and takes a form which affords no support for the camera, a quite practicable method is to hold the camera at arm's length directly above the head and to view the picture by looking up into the hood. As both hands are required to hold the camera steady, focusing is by no means easy: the camera should have a stout carrying strap so that one

hand can hold it aloft whilst focusing is being done. The most troublesome thing is to make certain that the camera is being held level but nevertheless this is a method which is of much service on occasion. It requires the mirror to be of the spring-raised type.

The photograph of Swanston, R. L. Stevenson's home in this issue, was made in this way. The little estate stands within a close hedge and only by this means could a photograph be obtained of it from outside.

Apart from photographing over an obstacle, this high upside-down position of the reflex is useful in dealing with scenes where it is required to spread out the foreground. Fountains, flower-beds, ornamental waters, are examples of subjects which are more effectively rendered in this way. A rapid exposure requires to be given in order to provide against unsteadiness of the apparatus while so held.

Figure Studies

For this class of subject, the chief thing is to keep the camera from attracting the attention of figures when it is desired to photograph them free from the awkwardness of a self-conscious pose. A long-focus lens is a great help as it allows of one stalking one's subject from a greater distance. But the more effective means of avoiding or disarming notice lies in abandoning the usual conspicuous plan of holding the camera. Instead, we can make a feint of photographing in a different direction. Think of the subject as placed in the space below the type on this page. Then if we take up a position facing, say, from right to left, across this page, the camera can be held with its side against one's body, so that the lens points directly toward the subject. With a sunk lens, as fitted to most box-pattern reflexes, the real purpose of the apparatus is not at all evident. One then sees sideways on the focusing-screen the subject which lies directly on one's left, although by action of one's head straight forward one conveys the impression that the subject lies there. This system is workable with a fixed hood although it is much more conveniently carried out if the hood can be reversed so that the long dimension of its mouth runs lengthways with the camera (as shown in Fig. 5,

which illustrates this method). This position of the hood aids the deception, and it is also of advantage to have focusing-head and shutter-release on the same side of the camera.

Another plan, though not so effective, is to stand with one's back to the subject as shown in Fig. 6, pushing the reflex through the short tunnel made by one's

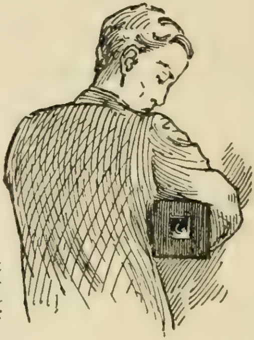


FIG. 5 (left). Pointing reflex to left while taking a position in forward direction. Hood reversed. FIG. 6 (right). Photographing with reflex held under arm.

arm and looking sideways at the ground-glass. Still another method is to focus and compose the subject by using the camera in the ordinary way and then, as if dissatisfied with it, to face round in the opposite direction or to stroll away, at the same time closing the hood. Then if it is seen that the figures have returned to a natural pose one can turn about swiftly and return to the previous spot, bring the camera to the front, quickly sight the subject, and make the exposure.

A Lens-Mirror

Another and most effective plan for thus drawing attention away from the photographer's actual operations consists in the use of a second mirror placed in front of the lens at an angle of 45° to the lens axis. With it one photographs to one side or the other while the lens and the operator are looking straight in front. The worst of this method is its cost. The silver-surfaced glass requires to be optically flat, is liable to be damaged,

and, owing to its exposed position, may frequently require re-silvering. On the other hand a permanent metal mirror such as Kahlbaum's is very heavy and costs not much less than the reflex to be fitted with it. The only practicable plan is to mount a glass mirror in a tube or box provided with a door which can be kept closed when the attachment is not in use. The accessory is made to screw on to the camera lens and can be constructed to look like a larger objective. In fact the more conspicuous the whole fitting is, the better for disarming suspicion. By means of it, exposures at quite close quarters may be made entirely unknown to the subjects and the accessory has proved of value in obtaining records in countries where the camera is feared or tabooed on religious grounds.

Copying Work I have already referred to the usefulness of the reflector type of hand-camera in photographing quite small things on a fairly large scale with the camera held in the hand. In that respect its chief merit is time-saving. If you are using a hand-camera such as an F. P. K. in which focusing is done by means of a scale, the only really satisfactory plan of dealing with objects a few feet away, say 2 to 6 feet, is to measure out the distance and then to set the focusing-scale accordingly. That is a rather slow job and with a wide-aperture lens is not free from uncertainty. With a reflex it is just as certain and rapid an operation as photographing a distant landscape. If your camera is of the double-extension pattern the ordinary lens is as good as any other, for if it can be placed twice its focal length from the plate an object can be copied same size, although such a large scale will rarely be wanted. If of single extension, it may still extend far enough for all but the most exceptional subjects: or a short-focus lens, specially for use in such cases, can be provided. In any case, remember that whenever extended appreciably beyond the distance for focus on distant objects the working aperture (F number) of the lens is no longer that marked on the mount but is the extension divided by the actual diameter of the stop in use. It is a simple matter to find out what these stop values are for, say, every inch of

extra extension. In doing this it is necessary to get the figures only for the largest stop of the lens. If it *is* necessary to use a smaller—it usually isn't—you need only give twice or four times the exposure in the usual way. For example if the real *f*/ number (full *f*/6 aperture) is *f*/10 and you have to use the stop marked *f*/8, you need to give double that required for *f*/10 or four times if the lens is stopped down to *f*/11.

Orthochromatic Exposures

One point in favor of a reflex which I have not touched upon is the facility of making exposures with a light-filter. The large aperture of lens which can be used coupled with the high efficiency of the shutter at a slow speed makes it quite practicable to give exposures of one-tenth or one-twentieth of a second through a five-times ray-screen on average subjects. A tenth of a second is about the slowest exposure which a focal-plane shutter will give and this is the speed which should be used for orthochromatic work. If a less degree of exposure is sufficient, it is secured by the use of a smaller stop.

High-Speed Work

In the photographing of subjects in the most rapid movement we come up against difficulties each distinct in itself but all connected together. The chief thing is that the negative should be free from blur due to movement of the subject, i. e., that the motion should be "arrested." Whatever else the photograph may be it is self-condemned if it is not that. A moment's thought will make it clear that the shutter-speed which is necessary depends not directly on the movement of the object but on the movement of the image on the plate. The shutter aperture must move over a given space of the plate at least a little faster than the image moves on that part. The movement of the image depends on several things which we will consider in a moment. Also with many subjects it is necessary to secure depth of focus. If that is done by stopping down the lens, the difficulty of striking a balance between an exposure short enough to stop any movement in the subject, but long enough to give a developable image on the plate is made more difficult, whilst a further factor which requires to be taken into consideration at times

is the avoidance of distortion due to the fact that the focal-plane shutter exposes the plate not all at once but in successive bands or sections as it were, each the width of the curtain-aperture.

Subject versus Plate

In all high-speed work it is the subject and its sharp rendering which comes first. Ideas of correct exposure of the plate on the lines customary in ordinary photography must be given second place. Up to a speed of about one-three-hundredth of a second it is fairly possible to make negatives which are fully and correctly exposed in the sense that those made by time in a view-camera are fully and correctly exposed. But at higher speeds than that one-three hundredth to one-one-thousandth—it is largely a matter of making the most of the light-action which the plate has received. Don't take this as representing work in this region of higher speed to consist of feats of skill or chance successes. A very large proportion of ordinary hand-camera negative-making is marked by exposure which comes very far short of what is correct or full but is acceptable all the same. What I am seeking to enforce is that an exposure of one-five-hundredth or one-one-thousandth of a second may be given under conditions when in strict accordance with exposure tables one-one-hundredth or one-two-hundredth ought to be given and the result will not be altogether disappointing. The character of the plate and its method of development play their part, in addition to the fact that in high-speed work it is the form or drawing of the subject which is the chief consideration. The correctness of the scale of tones, for which correct exposure is a most essential condition, is of secondary importance. In the early days of the focal-plane shutter dry-plates were a good deal less sensitive than the ultra-rapid emulsions now obtainable, and it was not possible then to think chiefly of arresting motion and to let the exposure of the plate take care of itself. While modern improvements in plates have not been altogether such as to allow us to take their speed as sufficient for all high-speed work in reasonably good conditions, they are so much nearer to that ideal that in a very great

deal of work we can make the speed of the moving subject the basis for the setting of the shutter and need not fear that the plate will thereby receive a hopelessly insufficient exposure.

The Moving Image

Apart from the actual speed of the object, the speed of movement of the image on the plate depends on two things: (1) The direction of the moving object in relation to the axis of the lens and (2) the relative size of the image or, in other words, the scale of reproduction. The image is larger and therefore moves faster the nearer it is to the camera or the longer the focus of the lens. As regards securing sharp definition of a moving object, it doesn't matter whether an image of a certain size is secured by a near standpoint or by the use of a lens of longer focus further away. The latter plan, as we shall see, has advantages over the former.

Direction of Movement

First think of factor No. 1. If the object is moving straight toward the camera—let us suppose exactly along the lens axis—the image as a whole does not move on the plate. It only gets larger. On the other hand if the object moves directly across the field of view, that is at right angles to the lens-axis, the movement of the image is at its maximum. In practical work this is one of the first things to recognize. Comparatively few sporting subjects can be taken "dead on:" it is out of the question to plant oneself right in the path of runners or a horse-race, apart from the unsatisfactory nature of the photographs so obtained. On the other hand if the subject is passing straight across the field of view, the result is equally unpleasing pictorially whilst the exposure requires to be something very much shorter in order to avoid blur due to movement of the image. Therefore on both counts, the best plan is to take a position so that the lens points in a direction about "half and between" these two extremes, as illustrated in Fig. 7. In other words not as at A or B but as C or D so that the direction of the moving object makes an angle C (45°) or D (30°) with the lens-axis. In these circumstances the shutter requires to be worked at a speed about two-thirds that necessary in position

A, though about twice that required in position B. In taking up this mid-angle position everything depends on the distance one wishes to be from the object at the chosen instant of exposure which brings us to the next point, i. e. relative size of image.

Size of Image

The basis of all calculation here is that the proportion of the image on the screen to the actual movement of the object is exactly the same proportion as the size of the image to the size of the object. The object may be

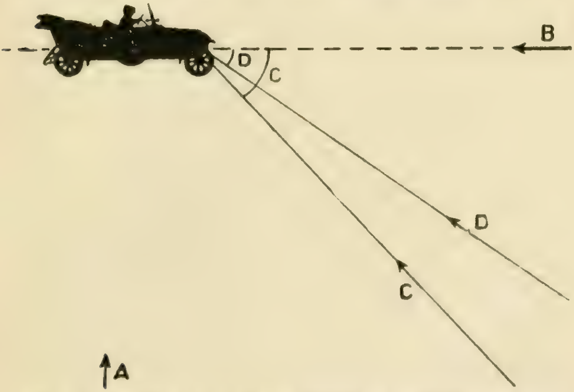


FIG. 7. Positions *A*, *B*, *C* or *D* of camera for photographing object moving in direction of dotted lines. *A* represents maximum movement of image on plate. *C* or *D* is a favorable position for average work.

traveling at a high speed, but if the image is minute on the screen through the great distance of the object or the short focal length of the lens the movement of the object will be minute and *vice versa*. How then are we to make allowance for different distances and focal lengths of lens in fixing on a standard for working? Very simply, by leaving these things out of account and fixing on an image of a certain size. As a rule the subject will be a man or a horse, the height of either of which may be taken as 6 feet. A convenient size for the image is 1½ inches which is a degree of reduction of one-fiftieth.

Distance from Object

Now perhaps we begin to see some order emerging from the chaos of these questions. If we remember our optical rules, or, alternatively, if we can refer to THE PHOTO-MINIATURE No. 140, we shall know that for an image one-fiftieth the size of the object, the distance from one to the other, or nearly enough for practical purposes, is fifty times the focal length of the lens. That is to say for a 1½-inch image of a 6-foot man or horse the distances of the camera with lenses of various focal length are as follow:

LENS—FOCAL LENGTH Inches	DISTANCE Feet	LENS—FOCAL LENGTH Inches	DISTANCE Feet
5	21	12	50
6	25	14	59
7	29	16	68
8	33	18	76
10	43	20	84

These are rough indications to go by but it is not necessary to remember or judge them when using a reflex: a couple of pencil marks 1½ inches apart on the focusing-screen will serve for adjusting matters. Though the subject proper will not be available beforehand for this purpose, it is almost always possible to find a man standing where it is intended the subject should be and to take such a position for the camera that his image just about fills the space between the two marks.

A Working System

So here we have roughed out a system, viz., a 1½-inch image of the human or equine subject on the focusing-screen, and at the same time a standpoint for the camera such that the subject presents itself about half sideways-on (C or D, Fig. 7), or rather will do so when it gets to the point at which the exposure is to be made. More often than not, one knows what its course will be and can judge this latter. At the same time let it be understood that this is not a hard-and-fast rule but on the contrary one to be departed from as circumstances suggest. It does, however, provide a basis by which to judge variations which are needed or advisable. If the image is larger we know the exposure most be shorter: if it is

smaller, we can do with a rather longer time for the benefit of the plate.

Subjects and Shutter Speeds

Under the conditions defined in the previous paragraph fair indications of shutter-speed are as follows:

Horses, galloping or jumping	1/900	Diving	1/600
Horses, trotting	1/800	Golf and Tennis	1/1000
Cycle- (not motor) racing	1/500	High jump	1/800
Foot-racing	1/500	Vehicles (10 miles per hour)	1/200
Fast skating	1/700	Pedestrians	1/80

If the subjects are moving across the field of view these exposures require to be about one-third faster, that is to say the lower figure in the number for the fraction of a second requires to be about half as much again—one-nine-hundredth instead of one-six-hundredth. If, however, the subjects are coming end-on to the camera, exposures can be about twice as long. As regards the size of image, one-half the size will allow twice the exposure whilst one double the size would need doubling the speed of the shutter. But the latter is not a practicable program for the fast subjects, on account not only of the incapacity of shutters but also of the inadequate exposure of the plate. The useful limit as regards size is marked, for fast subjects, by the 1½ inches and it is better to depart from it in the other direction of a smaller image and a greater degree of enlargement of the negative.

Limb Movement

In drafting the foregoing suggested exposures, the basis, derived from both experience and calculation, has been that of the rate of movement of the object as a whole. But it must not be forgotten that apart from this motion, say of a runner or a cycle, there is a still more rapid movement of the legs or the spokes of the wheels. To get this part-movement of the subject sharp on the plate the exposure must be considerably shorter, say, one-eight-hundredth or one-one-thousandth where one-five-hundredth would be quite enough for the general forward movement. Other subjects like diving, skating or the long jump do not come within this category:

the movement of arms or legs is not an extra to that of the body. In the case of galloping or fast-trotting horses or high-speed automobiles, one is usually working at the highest speed of the shutter and the only way to get greater sharpness of moving legs or wheels is to have a smaller image.

Focusing- and Movement-Blur

One thing which also requires to be kept in mind is that any shortcoming of the shutter in the way of insufficient speed is aggravated if the subject is not in really sharp focus. Of course the two things are quite distinct and it is easy to tell from the negative, especially with the aid of a magnifier, which is the cause of unsharpness. But if the cause *is* movement of the image during exposure, it is clear that such blur will be greater if the moving image is itself bigger than it should be through faulty focusing. This is liable to creep in particularly in dealing with sharply defined objects such as swords and lances in military sports, the club of the golfer, or the racquet of the lacrosse player.

The Swing Lens

I referred in the beginning to the use of a swing front to a reflex in high-speed work. The movement is very useful because it often enables one to get depth of focus without reducing the aperture of the lens. The most useful form of the movement is that of Adams and embodied in the "Videx" reflex by which the lens can be swung up or down or to the right or left (that is around a horizontal or vertical axis) according to the way the lens-panel is placed on the camera front. Most other cameras have only the up-and-down swing if they have any at all, whereas the sideway swing is the most generally useful. The up-and-down swing helps to bring the foreground and distance (or mid distance) into focus without stopping down, whilst the sideway swing does the same for parts of the subject extended horizontally across the field and receding from left to right or *vice versa*. This latter is of more common occurrence, for example a group of runners approaching the camera, say, from right to left in a diagonal direction. In this case the lens has only to be swung more or less toward the left and the subject focused on the screen with it

so swung in order to get the foremost man into focus at the same time as those behind. In the opposite case—figures approaching from left to right with the camera pointed at an angle of 45° or 30° to the line of travel (the C or D position of Fig. 7)—the rule is to use the lens swung toward the right. Try out this rule on standing figures and you will be able to judge of the amount of swing which is necessary. Care must be exercised in the use of this movement. If you swing the lens in the wrong direction you can make matters so much worse. The principle to bear in mind is that the lens should be swung so that it points further away from the more distant part of the subject. By so doing the rays of light forming the image of this part are skewed round, so to speak, and the surface in which sharp focus of near and distant is obtained, instead of being at an angle to the plate, comes more nearly into alignment with it—an aid to better definition.

Distortion

A lot has been said in the way of condemning the focal-plane shutter on the ground that the image of a moving object is formed piecemeal on the plate and not all at once as with a lens-shutter. For that reason, so we are told, the results with the focal-plane shutter must suffer from distortion due to movement of the image during the whole period of exposure. In theory that cannot be denied; in practice, as represented by perhaps nine-tenths of one's work, it is negligible, and in the case of the remaining tenth any distortion effect can be avoided by appropriate use of the shutter.

How Distortion Comes

Suppose you are photographing a runner moving *across* the field of view and are using the shutter so that the curtain runs from top to bottom of the plate. The image being inverted on the plate, and the direction of movement of the image of the figure being opposite to that of the figure itself, it follows that as the curtain-aperture comes down over the plate the feet or legs are exposed first and the head last. Hence the upper parts of the body have had a minute fraction of a second in which to move forward and therefore the figure may be rendered as leaning forward rather more than it act-

ually is. That is one way in which distortion can conceivably occur, the effect taking the form of an angling of an upright subject one way or the other according as the curtain-aperture uncovers feet or head first. Another way in which distortion may creep in is when the curtain-aperture (on exposure) follows the image of the moving subject. The effect in that case would be to lengthen or draw out the image of the subject.

Precautions Let it be understood that so far as average high-speed work—sports subjects and the like—this distortion effect can be put among the "would be's" and "perhaps's"—a pure bogey. It certainly is often marked in subjects moving at an excessively high speed, such as racing automobiles, but apart from focal-plane photographs themselves the best answer to critics of the shutter is the fact that some years ago a German professor found it necessary to take as his subject a 20-inch disk rotating at the rate of 400 revolutions per minute and placed only 4 feet from the camera in order to demonstrate the distortive effects of the moving slit. However it is of service to state the conditions in which distortion is least liable to occur. This is when the moving image of the object is met by the moving curtain-aperture, i. e. when they pass each other like two trains on a double track. Since the image moves in a direction opposite to that of the object, the rule is to hold the camera so that the travel of the curtain-aperture corresponds with that of the object. In most reflex cameras the curtain runs from top to bottom which is the best position for divers and falling objects. For objects moving right to left or *vice versa*, the best position is with the camera held on one side or the other which means that one must discard the viewing of the image on the screen, must focus beforehand on a given spot, sight along the closed camera and make the exposure when the moving subject has reached the appointed place. This is not an impossible method but actually the regular practice of press photographers. It will serve to avoid the slanting automobiles which one so often sees in the newspapers but it is an unnecessary refinement for subjects of less extreme speed.

Long-Focus Lenses

In high-speed work a long-focus lens offers several distinct advantages. Very often at public sports it allows one, from an ordinary seat in the spectators' stand, to do as well as the privileged press photographers in the enclosure. In photographing sports like throwing the hammer or putting the weight it removes one from positive danger. Moreover there is scarcely a single subject the "drawing" of perspective of which is not vastly better when taken with a 15- or 20-inch lens as compared with the average 6 or 8 inches. In fact, subjects like football or baseball, in which the players may move about anywhere over a wide field, can hardly be tackled at all except with a long focus. In Britain, the press photographers of phases in a big football match are almost always taken with a reflex of 4 x 5 or 5 x 7 size fitted with a large-aperture lens of 20 or 30 inches focus and mounted high up on a massive tripod, placed right off the field. In such circumstances, when one is working to get a figure of a given size, the long-focus lens is really at a light advantage as regards depth of focus.

—and Camera Extension

Fortunately it is not necessary to use reflex cameras at the long extension necessary for a long-focus lens of the ordinary kind; within the last few years opticians have introduced a type of lens—a fixed-focus telephoto—which is just the thing for high-speed work. Unlike other telephotos, the aperture is large, *f*/4.5 to *f*/6.8, whilst the camera extension required is just about one-half the focal length. The two lenses of this class which have been most used are the "Telecentric" of Ross and the "Large Adon" of Dallmeyer. The "Telecentrics" range from 9 to 17 inches focus (camera extensions, 5½ to 11½ inches); the "Adons" from 12 to 20 inches focus (camera extensions, 6 to 8 inches). Either is a power in the hands of the high-speed photographer in the ways stated in the previous paragraph and without the need of anything exceptional in the extension of the camera. I do not find lenses of American manufacture in this special class, but doubtless an inquiry addressed to the Bausch & Lomb Optical Co., Rochester, N. Y., would bring the reader definite information.

Development I come as a last word to development, on which point it is not necessary to say anything regarding the treatment of film or plates which represent exposures up to say one-one-hundred-fiftieth of a second under good conditions. For these the reader may take as his guide the instructions in THE PHOTO-MINIATURE No. 139: *Modern Methods of Development.* On the other hand there is not much which can be said about the development of exposures which have received, say, one-three-hundredth to one-one-thousandth of a second. In all such work one has to make the best of under-exposure, and though certain developers are recommended as better than others in such circumstances my own experience is that for quality in the print or enlargement pyro-soda is the equal of any of them. It should be weak in pyro, about 1 grain of pyro per ounce of the working solution, the two other constituents being soda sulphite (cryst.) and soda carbonate (cryst.)—about 10 grains of each. It should contain no bromide and be used not colder than 65° F., or as warm as 70° if the plate will not fog or frill; used with patience and kept moving over the plate the whole time, this developer will bring out as much as any other and will do as well as a much-diluted developer used in a tank.

BOOKS

"The Photography of Moving Objects." By Adolphe Abrahams. A manual of instruction in the use of the focal-plane camera for sports subjects—running and jumping, rowing, football, cricket, golf, lawn-tennis, etc. 1910. Cloth 60 cents.

THE PHOTO-MINIATURE, Series No. 77: "Focal-Plane Photography;" No. 91: "Photographing Outdoor Sports;" and No. 99: "Reflex Cameras," all contain much valuable information on the general subject of this monograph. They are all "out-of-print" with the publishers, but odd copies may perhaps be found by diligent inquiry among photographic dealers or at most public libraries.

Especially in home portraiture there are many opportunities for making pictures of children as they play by themselves
W. E. Burnell

J. F. Sipprell

A Dutch Baby
J. F. Sipprell

The simplest, least affected arrangement is often the most successful with boys
A. Gottheil

A Study in Character
Photographer unknown

A Flower from the Land of Sunshine
Edward H. Weston

Perhaps as good an example of professional child portraiture as one will meet with in a day's march—by a master in his profession
Frank Scott Clark

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Henry Havelock Pierce

A family group in the spotlight
W. E. Burnell

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W. E. Burnell

It would be difficult to imagine a more delightful bit of wilfulness than this

Mme. D'Ora

Portrait of My Son
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A Magazine of Photographic Information
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Photographing the Children

Ever so many thousands of children have come into this world, and many, alas! have gone out to play forever in the Elysian fields, since I first set forth in these pages some of the ways of making pictures of them with the camera. That little book is now out of print and far to seek, as is another which followed it; and so we are back again in the unhappy plight of having—among all the books on photography—no guide to this most delightful of pictorial fields. In which facts we surely have abundant justification for this new adventure, wherein we seek to find what these last few years can tell us about photographing the children.

The old world of child portraiture had a few splendid traditions, worthy of remembrance in passing. The workers then were almost wholly professionals, and the best among them followed the masters of painting in their treatment of the subject, giving us the children in shy reserve, always well or over-well dressed, and generally grave and dignified in demeanor, as befitted the ordeal through which they had just passed. Looking back at the charming child portraits of Falconer, Byrne, R. W. Robinson, Rejlander, Rockwood, and others of their day, one cannot but admire the skill with which they overcame the crudities and limitations of their tools and methods, and gave us so much of the spirit and life of their subjects. But for the most part, as our secretly treasured

family albums show, the professional photographer of thirty years ago failed to see and grasp his opportunities with the children—to the world's loss.

Changed Conditions

With the coming of the amateur and the introduction of modern methods, the making of pictures of children underwent a vital change. The ever-ready and convenient kodak made it possible to photograph the children outside of the studio and away from all its terrifying paraphernalia. The amateur began to photograph his own and his neighbor's children in or about the home, at their play, on holiday among the hills, or at the seashore. Later, the women folk were interested, and we had altogether different pictures of children, until today one may fairly say that the best of our child portraiture is beyond praise, giving us all the roguish abandon and grace of childhood, portraying with exquisite fidelity all its moods from grave to gay, vital with the illusion of its joyous life, just as we see it about us everyday.

Not all this advance in child portraiture, however, comes from the better tools and methods available today. We, too, have changed, grown-ups and children alike, in our outlook on life. The larger freedom of expression which has replaced the ancient evil of repression, so far as children are concerned, has made us the friends and familiars of our children in a measure undreamt of in the earlier days. And in this, without a doubt, lies the secret of our larger success in photographing them.

The Two Ways

So much being said by way of introduction, let us get to the heart of our adventure. In the evolution of the art, it has become plainly apparent that there are two ways of making pictures of children with the camera, which, though differing vastly in methods, are yet alike in the vital points. The first of these ways is the deliberate method followed by professional workers in the studio or at home. The place is prepared and the time appointed; when the child arrives, there is the securing of an understanding without which nothing can be hoped for, and lastly, the composition or

arrangement of the little sitter. The result is generally pleasing; it gives likeness, and is usually simple in expression and in good taste; a little formal, perhaps, and generally lacking in spontaneity, but almost always satisfactory to the parents and friends of the subject.

The second way, and naturally that most widely followed outside of the studio, is the hit-or-miss method of the average amateur. Here there is no question of time or place or dress, only the grasping of opportunities as they happen or can be made to happen, and a willingness to spend time and plates without a thought, with the children indoors or out-of-doors, making exposures at every favorable opportunity.

Combining the Methods

Sometimes the two methods are combined, as where the professional works at the home of his patrons and has a larger freedom in his work than the studio permits. Or, again, the serious amateur employs the deliberate methods of the professional studio in the home, and achieves the happiest results.

There is no superiority in either method, and choice between them is a matter for individual preference. One of the most wonderful child portraits I have seen was made by an amateur with a ten-dollar kodak, working at a window in the home. Another, equally wonderful in its illusion of life, was made by the crustiest professional I have known, working in a studio where everything was in utter confusion and disorder.

Apparatus

The questions concerning apparatus may be disposed of very briefly with the common sense and comforting advice to use the camera you have. In theory, certain forms of cameras seem better suited, or offer greater convenience and efficiency, than others. But some of the best pictures of children I have seen were made with the least expensive and apparently least suitable cameras in the market.

Reflex Cameras

For all work done with the camera in the hand, at home or out-of-doors, the reflex type of camera undoubtedly gives the biggest percentage of successes and

satisfaction. This simply because it is usually fitted with lenses of large aperture, working at *f*/6.3 or better, has a shutter giving the maximum amount of light at the plate during the exposure period, and has a full-size finder or ground-glass, on which the picture is seen in full size, right way up, to the instant of exposure. I am told that reflex cameras are even making their way into professional studios, on the ground that their use enables the photographer to follow his little models around, so that they can move about freely in the studio without restraint. Be that as it may, such a camera offers obvious advantages in and about the home, as well as for all outdoor excursions where children are concerned.

The View Camera

For serious professional work outside of the studio most successful home portraitists use the bulky, but reliable, square-bellows view camera, on a tripod, of course, and fitted with a silent studio shutter working inside the camera. This means that the children must be kept within a well defined area at the time of photographing, and the work proceeds very deliberately, which may make for weariness and self-consciousness unless the subjects are happily occupied or interested. Such a camera is perhaps the best for flashlight work, and especially portrait groups, at home.

Hand Cameras

The hand camera will give us all we seek if skilfully used with an eye to its obvious limitations. Indoors, always, it must be used on a tripod; but out-of-doors the tripod will rarely be necessary. The newer models, equipped with anastigmats working at *f*/7 or better, and exposure shutters giving actual exposures of one-twenty-fifth and one-fiftieth second, will meet most of our requirements. Such exposures are, of course, met with only in outdoor work in bright light. At other times, exposures of one-tenth second, and bulb exposures made with the camera supported or braced in some way, will generally give well-exposed negatives. Indoors, the exposures will most often be bulb, holding the shutter open as long as the subject permits, up to one, two, and sometimes three seconds.

With a lens at *f*/4.5, you can sometimes make an exposure of one-tenth second indoors at a window.

What to Avoid

In photographing young children, quickness and quietness of manipulation and movement are big helps to successful negatives. Children between the ages of four and twelve quickly tire and get restless if there is much fussing on the part of the photographer, and a strange noise or movement about the camera is apt to distract their attention. All of which supposes that a serious portrait is being attempted. As a general thing, one's little subjects should be so interested in a toy, or a story, or some simple occupation, that they will be largely unconscious of the part played by the photographer and his camera.

Plates or Films

So far as plates or films are concerned, there is little room for preference. Roll-films and film packs help by their simplicity and convenience in changing after exposure. For pictures 5 x 7 or larger, made away from the studio, the new Eastman protrait films are very desirable, as doing away with the bulk and weight of glass plates.

When working indoors, a tripod-stay, such as may be had for a dollar, will often save one from disaster, apart from the general convenience of having one's camera support rigid and reliable all the time. And, for portraiture out-of-doors, let me urge the use of a lens-hood to shield the lens from the bright light.

Working at Home

It is an old notion of mine that photographs of children should be made by women in the home, because children are more freely responsive with women and more freely and naturally themselves, without restraint or self-consciousness, in the home. The world has not yet wholly approved the notion, and most of our loveliest portraits of children have been made by men working in the conventional studio. But more and more, year after year, the children are being photographed in the home, and the women are doing a large share of the work. So, clinging to my notion, we will here deal first with photographing the children in the home.

Imaginary Difficulties The use of the ordinary rooms of the home for this purpose is supposed to offer many difficulties, such as the lack of sufficient illumination or of suitable background, the avoiding of heavy furniture and furnishings of dark color, etc. But in these days of furnishings in in light tones, plain wall coverings, fast lenses, and rapid plates, the difficulties are plainly imaginary. So we find that the professional has no difficulty in securing pleasing portraits in the home. Certainly, the compensations and advantages of the home far outweigh any difficulties which may be encountered, and usually the exercise of a little common-sense resourcefulness will obviate them completely.

The Cadbys Some of the most charming of our modern portraits of children may be found in the work of Will and Carine Cadby, two English specialists in child portraiture, whose work is invariably done in ordinary rooms such as every home affords. Their methods and work are strikingly original and afford many common-sense suggestions for all who work in the home by choice or otherwise. Doubtless most of my readers can recall the characteristic Cadby portrait, a simple and wholly pleasing arrangement of subject, accessories, foreground and background, carried out in light tones, with a delicacy of line and form suggesting a clever pencil-sketch rather than the conventional photograph.

Their Methods How are such pictures made? Fortunately the Cadbys have been generous in telling of their ideals and methods, so that we can learn from them almost all we need to know about the photographing of children in the home. I will quote them from the "Amateur Photographer" and the "Australasian Photo-Review."

Photographer and Child It may sound a platitude, but it is nevertheless a fact which is not sufficiently realized, that the relations between the photographer and his model are amongst the most important factors in obtaining satisfactory portraits, especially of children. But what are satisfactory portraits? Alas! this is a most difficult ques-

tion to answer, for opinions differ—differ so widely that it is not an uncommon occurrence for friends to look coldly on the photographer's triumphs, and praise what he considers his failures. However, in spite of our differences, we all must agree that a child's portrait should be natural, simple, and spontaneous; and, if we can add to these essentials some slight artistic interest by the subtraction of unnecessary and mostly irritating detail of surroundings, we shall certainly enhance the value of our work.

We are aiming, then, at Naturalness, Simplicity, and Spontaneity, and as the relationship between the photographer and the child is directly connected with the attainment of these qualities, it is worth a little consideration and thought.

I have sometimes been told by photographers of their various ruses for keeping children amused while they were composing and focusing their pictures. How they have interested their little sitters with exciting stories, played a sort of Punch and Judy show from behind the focusing cloth, and have impersonated all the beasts of fact and fiction. I gaze and listen, in wonder not unmixed with admiration, for it must be confessed I can do nothing of the kind, for all my energies are absorbed and often, indeed, exhausted in watching, composing, focusing, refocusing, and recomposing, and, if lucky, slipping in an occasional plate and getting an exposure.

Introducing the "Amuser"

And so I hold the photographer's relation to his child sitter should not be a too exciting or absorbing affair. He should, of course, be on good terms, even occasional chatting terms, with the little model; but the real amusing should be done by a second person, and lucky indeed is the camerist who has a sympathetic helper for this essential work. The entertainment should never be of the fast and furious type. The more the child amuses itself the better. The greatest skill is shown in unobtrusively suggesting and controlling the direction in which the amusement should go. The real expression and pose of a child come from within, and not from without. As an instance of this, watch a

child's face when it is being told something, and when it tells something itself. The uttering of an idea or thought will alter the whole face, and what was lifeless while listening will be lighted up when expressing itself.

The great thing is to keep the child sitter as normal as possible, and if the amuser can contrive to make him forget altogether that there is a camera and a man behind it in close proximity, and this without undue excitement, then the amuser's work will be done, and the photographer will be left free to watch for and seize his opportunities, which, if the child is quietly and rationally amusing itself, should soon appear.

But how, probably asks the reader, is the volatile young sitter to be kept in one place? This is the business of the amuser, who is greatly aided by arrangements of background and foreground, which will be more fully described later on. And so, skipping for the present the surroundings of the child, we pass on to the consideration of posing.

Beware of Posing

Speaking broadly, a child should hardly ever be posed. Even the most self-conscious youngster, with dexterous management, can be induced to forget itself, and when once this is accomplished, ease and grace as if by magic appear. The one unforgivable sin in the portrait of a child is self-consciousness, and so it must be avoided at all costs. Boys quite as much as girls suffer from it, and will often completely spoil a picture if asked to "keep like that just a second." Indeed, the suggestion that they should look at the camera is almost always followed by disaster. Consequently, with children that are at all nervous, full-faced portraits should be avoided. But of course self-consciousness is just as noticeable in figure as in face. The prim little girl who has made up her mind beforehand exactly how she will sit for her photograph, and is bent on carrying it out, may even necessitate the imaginary exposing of several plates, and then, if the photographer will with some ostentation pronounce it all over, he may, if he is quick and has his plates quite handy, immediately get some good natural relaxed portraits; for when once what is considered the ordeal

is over, the child, in common with the adult, will straightway relax and usually look its very best and most natural self.

Children are often best taken standing, for they naturally spend so much of their time on their legs; but if kept long they are likely to get stiff and set. If this awkwardness does not go of itself, much may be done with quite little children by the amuser jumping them up in the air. They seem to land again on the floor with quite a new stock of strength and grace. Again, most difficulties with little girls can often be surmounted by the photographer taking them into his confidence and getting them to help him make a picture of their favorite doll, or a real live kitten will answer the same purpose. They will busy themselves over such subjects, and never seem to dream that the eye of the lens is impartially including them as well as their pets.

And all this trouble is to be taken to avoid self-consciousness! Yes, and it is worth it, and that is why I have rather gone into detail over means to avoid this unforgivable fault in a child picture; for is not even a poor snap-shot of a natural, spontaneous attitude worth more than the most technically perfect negative of a consciously posed goody little person?

The Scheme of Tones

My aim in child photography is to get a delicate scheme of certain light tones. They are all to be in a high key, and the lowest note must be but a gentle gray. The scale, which is short, is in the treble, if one may use such an expression photographically. The gradation of the tone values will be absolutely correct, the rendering of the flesh will be distinct from the background, and the clothes will not compete with the face. My scheme must be restrained, and entirely simple, and only those lines will appear in it that are necessary for the composition. There will be a gentle emphasis, subtly suggested in exactly the right place, and the whole shall be a pearly effect—suggesting evanescent childhood—something, let us say, between a Whistler and a Corot, only in black and white! Needless to say, I have never achieved it! The camera, no doubt, has

vast latent possibilities, but, so far, I have had to be content with simplicity and naturalness. Whatever else I have had to let slide, over that part of my aim I have maintained a rigid determination: simplicity in dress, surroundings, and lighting, and naturalness in pose and expression.

Simplicity in Cothes

Simplicity of clothes is easier to get nowadays; modern frocks are not so complicated, nor are nurses allowed to deck their charges out in unsuitable garments. The child photographer does not want an enveloped model, and personally, I clamor for out-grown clothes of a light color; not white, to mothers' and nurses' distress! Clothes are of vital importance in two ways—as affecting the photographer and as affecting his model. So far as the photographer is concerned, they can make or mar his picture. For instance, if he is aiming at a light, delicate effect, what is he to make of black stockings? And if he uses a white background, how is he to preserve the outline of form with a dead white frock? Dead white is always one of the child photographer's bogies, and one which haunts him pretty persistently. Some years ago a millionaire's wife dressed all her children in white, and ever since then mothers, like sheep, have followed her lead and thought it essential that their olive branches should wear nothing but this unpractical raiment. From the photographer's point of view, white is almost hopeless, for children's faces and hands suffer by the contrast, and to get any detail in the white, one has to sacrifice the flesh tones, so that a fair child comes out with a dark face, and a dark child resembles an Asiatic!

Old Clothes for Choice

Tumbled brown holland, cream and light-colored flannels and silks are ideal clothes to work with; and, O mothers! Nannies! or whoever dresses the young person, let the clothes be old! Out-grown clothes are invaluable, for the more one sees of the children's arms and legs the better, and a nice ample sleeve that covers up just half the hand, or a roomy, long skirt made to grow in, are terrible handicaps to doing good work. And as for starched clothes, I connot conceive a torture bad

enough for the barbarous Philistine who invented them for children. Even if he were dressed himself in stiff and crackling paper, it would not be half uncomfortable enough, for we grown-ups have not the quick movements of a child, nor are we so near to Nature. How is the poor photographer to get natural and spontaneous child studies with starched clothes? How can starched lines hang gracefully or suggest the form they cover? And whatever individuality of the wearer had got into these garments the starch and iron would take care to thoroughly obliterate.

And now for clothes as they affect our subjects. If we grown-ups, with our hundred and one cares and interests, are so conscious of the influence of clothes, how can we expect a child not to feel it? One has only to watch a small person who has been put into some new garment, to see how it alters, not only the movements, but for the time being the behavior. The boy, with his hands in the pockets of his new breeches, will strut, bursting with self-importance; the little girl will look down at her new frock, swing the skirt from side to side, and is sometimes so absorbed she will forget to answer a question.

Of course, children differ, and some like and some dislike new clothes intensely; but, whichever be the case, the wearing of them destroys, for the time being, all naturalness and ease. Old and everyday clothes allow the little people to forget the subject altogether, and it is this happy condition of unconsciousness that is absolutely necessary to the child photographer.

Surroundings

Surroundings are more easily controlled. We try to get an absolutely white background and foreground, and accessories are avoided unless absolutely necessary. For instance, if a child is actually playing, then the toys and table have to come into the picture; but it is simple to select these of a color to harmonize with the light scheme, and be subservient to the chief interest.

Rooms vs. Gardens

To my mind, the rooms of the house are preferable to a garden for work of this kind. The garden, although the light in it is rapid, is not to be recommended for pic-

torial work. Children are more excited and out of control, and are sure to be distracted by a hundred natural sights and sounds. Dolls, bricks, and story-books temporarily lose their charm, and the camera is not likely to be tolerated. Then again, even if the children behave well, backgrounds that have been carefully rigged up have a knack, even on the stillest summer day, of falling a prey to gusts of wind that seem to come from nowhere, and certainly ruffle nothing else but our background and tempers. So we are driven into the house, where, if we can find a room with a fair-sized window—two windows by preference—which do not admit the sun, we can get to work with larger chances of success.

Illumination

Now there is a good deal more light in many ordinary rooms than those who have not tested it would believe. I know many in which an exposure of one-third of a second will give good negatives of *light subjects* from March to September, with the lens working at $f/8$. I am, of course, supposing that very cloudy, dark days are not chosen, and that the fastest plates procurable are used. This is one reason among others why children's photographs should be kept as light as possible; and a very cogent one, for it shortens the exposure.

From close observation, I have noticed that children who are quietly playing will have continual spells of animated stillness, exceeding in length a third of a second, and it is these spells that we have to watch for, bulb in hand.

In these photographs everything should be light. There is no harm, although many are against it, in having a dead white background. But it must, at any rate, be light, and on the floor should be spread a sheet. Even if it is not intended to take the child full length, it is advisable, for it will help to shorten the exposure, or, what is often more satisfactory, it will enable us to get a better exposed negative with the same exposure. Any accessories that are used should also be light. It is quite easy, for instance, to get a white painted table and stool. It will take the average child but a short time to take possession of the stool, especially if a few

well-chosen toys, such as white bricks, are standing invitingly on the table alongside, and we then have our model happily anchored in one place. Even if he takes occasional excursions around the room, he will usually, of his own free will, return to what he quickly comes to regard as his own little house and grounds. And it is worth while at the outset to get this idea into his head.

But apart from the utilitarian reasons for making light photographs of children, it seems the rendering most fitted to their years. Youth and gaiety cannot be suggested by somber colors, and children, who, after all, embody the springtime of human life, and whose very charm is ephemeral and rapidly passing, should certainly be treated lightly by the camera.

Lighting and Exposure

Naturally lighting plays a very important part in our method. It should be somewhat flat, a large window in front of the sitter answering well in this, and there should be no top light. White walls or surrounding screens reduce the exposure necessary amazingly, besides helping to soften shadows almost to the vanishing point.

I have mentioned exposure, the most vital detail of all; for, however carefully we arrange everything else, it will be utterly useless if we under-expose. The result will be a caricature of what we have aimed at. Instead of delicate and subtle light tints, we shall have harsh contrasts. It is not a pleasing sight, and I, for one, cannot help a mental shiver at seeing in professional windows (alas that I must own it) these under-exposed portraits against a white background. Imagine children of ostensibly English parents with legs that would grace a Kaffir!

This is mostly due to under-exposure, as my impatient readers are no doubt longing to tell me; but I should like to hint that the top lighting has something to do with it, and, if I might hint further, a white background has no *raison d'etre* unless a delicate effect is aimed at. This is obviously impossible when, through insufficient exposure, tones are so distorted as to render flesh tints black.

While on the subject of exposure, it is only fitting to mention development. Probably every photographer of experience has his own ideas as to the best way to secure a certain class of negative, and so I need only add that for the sort of effects under discussion I prefer a weak solution and long development, as in the tank method, even with a full exposure.

Team Work I have said that we are content to aim at naturalness in our portraits of children. To this end it is essential that they are made to forget the camera, or they will become as stiff and conscious as the worst of their elders. Personally, I find it quite impossible to devote myself to getting a picture on the ground glass, and amusing and diverting the subject of it at the same time. Consequently, the taking of these portraits becomes the work of two people, which is the reason for the plural pronoun throughout these notes, and the sympathetic helper who knows exactly how much amusement is necessary, how to coax the child into focus and keep him there, and in what direction his attention should be directed, has just as big a share of responsibility and triumph when a success is scored as the man behind the focusing cloth.

Babies If we are going to photograph babies, we have one of the most fascinating, as well as one of the most difficult tasks the camera can set us. Fascinating, because there is a charm about all young things; and, whether grave or gay, the sitter is sure to be perfectly natural; and difficult, because—well, to put it as kindly as possible, all young people up to the years of two and a half are sure to be delightfully irresponsible.

Preparedness First of all, then, we must be thoroughly prepared before the baby is brought into the room. The background and foreground must be all arranged and a scheme of amusement thought out beforehand, for no one gets bored quicker than a baby. We must also grasp the fact that, however sweet and accommodating the small person is at first, it is not going to last long, and the most robust baby soon tires—in fact, twenty

minutes is the outside limit. This is rather surprising to those who think there is no strain where there is no consciousness. But although the child does not understand what is happening, however young it is, it feels a certain restraint at being kept in one place, and also one cannot help thinking it feels the effect of the anxious attention of the grown-ups concerned. Tears at the beginning of the sitting do not matter at all—they vanish and leave no trace; but tears from tiredness at the end are disastrous, hopeless for any more photographs, and a reproach to the photographer for having kept his model just too long.

When all is ready and the baby brought into the room, all deliberation vanishes, for the object now is to lose no opportunity. The mother or nurse who suggests that "Baby" will not be good away from them, and who are not wholly averse to coming into the picture themselves, must be cajoled away, and will often find, to their surprise, that "Baby" is not heart-broken; for even babyhood shows traces of weak human nature, and a bright, new, glittering toy will compensate for the absence of the devoted parent.

A baby dearly loves a little chair; and if the photographer can provide one, his work will be greatly simplified, for the novelty of the chair and the joy of sitting in it will keep the small sitter more or less in one place. Standing is far more of a problem, and, if we are ambitious enough to try it, the one who helps must not be far away. She—it will probably be she—must almost hold the baby, but so entertainingly that it does not suspect coercion, while the focusing is going on; and, when the plate is in and the photographer ready, efface herself at the exact right moment. A baby simply standing up!—what looks easier? and yet how difficult it is, and what a triumph when attained!

Exposures

The exposure must receive all the attention we can spare from the baby, and nothing must be left undone to render it as rapid as possible. We must scheme to get the brightest light, and use the fastest lens we have, and buy the most rapid plates. A light background and foreground will help, as they will reflect light, and also

give a light effect. Under-exposed baby photographs, coarse and with harsh contrasts, are unpardonable; for surely representation of such young things should be suggestive of delicacy and lightness!

To obtain delicacy, a full exposure is necessary; and as we know it is no good contemplating a long one, it is essential to secure a good light. A studio with a top light is not at all necessary, neither is a top light very suitable for children unless there is a strong side light as well; but, provided we use the brightest part of a bright day, an ordinary room will do quite well.

Then, to get delicate, gentle negatives, we have to be very careful about development, and often a plate we know to have been under-exposed can be saved by a slow and weak development; it cannot bring out the detail in the shadows, but it can remedy harsh contrasts, and give a more gentle and pleasing result.

Most parents realize the difference between babies—their own and other people's!—but ever such a small experience teaches the photographer that babies differ almost as much as grown-ups. All the characteristics are there in embryo which later on develop into an individuality, and to be successful the photographer has to take this into consideration. We must just let the merry baby smile, and the serious one look grave and wise. We must also be contented with what we see, and let no chance escape us.

It is no good either, having economical ideas with regard to plates. When we see good attitudes and expressions, the only thing is to be absolutely reckless, and just rattle plates off as fast as we can. Neither must we grieve afterward about the great number of spoilt ones; if we have secured ever such a few good ones, it should be triumph enough. Much baby photography makes us very humble and patient, and grateful for small mercies!

Expression

The expression with babies is a far more difficult matter than with grown-up sitters, who have so much more control over their features. A baby can so easily, and all in a second, make itself absolutely hideous. After all, one wants to get a pretty baby and, when the normal

expression is pretty, the photographer has to discard many negatives with charming attitudes because the expression has taken all beauty out of the face. For this reason, the helper, whose business it is to keep the child in one place and a good temper at the same time, has no easy task, for she must interest the baby, without in the least exciting it, and she must get its attention, while avoiding anything that will startle or spoil the normal position of the features.

One cannot exactly recommend baby photography as easy work, but one can guarantee it as interesting and exciting. If one starts, one will probably go on, for the poorest results have a charm of their own. Thus far the Cadbys and their methods.

Silhouette Portraits

I often wonder that we see so few silhouette portraits of children. They are easily made in the studio or at home; they offer a pleasing variation from "the usual thing" and, because of the novelty of the procedure, should strongly appeal to the interest of the little subjects themselves—a vital matter in photographing children. Properly introduced, this revival of an old art will undoubtedly make a profitable specialty for the professional worker, especially for the holiday season. Of the new interest the silhouette would add to the amateur's collection there is no need to speak.

How to Make Them

The modern silhouette portrait is generally made by the use of a flashlight. But for the women at home and those who do not care to use the flashlight the following daylight method may be preferred. It is given by U. E. Daubeny in "American Photography," February, 1915. I quote:

"Choose a room which is preferably lighted by only one window, and an hour when that receives no direct sunlight. The position of the camera should be close against the wall, the sitter coming between it and the window (see diagram). Facing and at a distance of not more than two or three feet from the window-containing wall, place the sitter, who should be in such a position that no light from the window can fall on the profile to be photographed. For background, hang

over a screen or other convenient support a white cloth or sheet, at right angles to the line of vision drawn from the camera lens to the sitter, and in such a position that it reflects the full light of the window. This background must be as free from creases or folds as possible, though, as it should be sufficiently

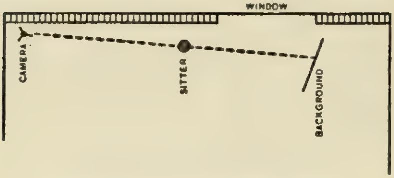

DIAGRAM SHOWING POSITION OF CAMERA AND SITTER

SILHOUETTE
UBRIO E. DAUBENY

far behind the sitter to be completely out of focus, this detail is of minor importance. If the wall-paper of the room is light, and therefore likely to reflect light onto the sitter's face, it will be found advisable to hang up a dark cloth or a sheet of brown paper—easily accomplished by the aid of a couple of drawing-pins.

Focus as sharply as possible on the profile, and from the point of view of a portrait very considerably underexpose. Remember it is the light of the background that is being photographed, the profile playing the part merely of an opaque black shadow. It is always advisable to use backed plates for silhouette work, so as to preclude possibilities of halation.

Study carefully the profile of the head and neck before exposing the plate, and have any objectionable or confusing feature of clothing altered or removed. In the case of a girl sitter, it is always preferable that the neck should be bared as low as possible. Close-fitting neckwear in shadowgraph gives an unnatural appearance which is highly unbecoming, and can be removed only by skilful blocking-out on the negative.

Develop negatives until the background appears a good deep black, but not sufficiently for any detail to appear on the profile. Prints should be made on gaslight, bromide, or platinotype paper, development

being continued until the profile is a uniform dead black.

Should the background not prove so flat and white as desired, it can easily be blocked out in the negative, either by thoroughly staining the film with red ink or by the usual application of opaque blocking-out preparation. A very simple and at the same time effective and easily applied blocker can be made by mixing red or yellow ocher powder (obtainable from any paint-dealer) with equal parts of water and gum, and applying to the film with a soft brush. In any case, it will be found necessary to block out portions of the shoulders and body that are not required, though this may be easily done by cutting out to the required shape a piece of light-proof paper and sticking it on the reverse side of the negative.

For those who prefer it, the actual profile may be cut out either with small scissors or with a sharp knife on a piece of glass, and stuck on a background of plain paper. This does away with the necessity of blocking out of any description, but requires a steady hand and considerable practice before it can be really satisfactorily accomplished.

The finished print in many cases will be improved by judicious touching-up, India ink and Chinese white being the simplest touching mediums for the purpose. In this way pinholes or other blemishes may be easily removed, and the actual profile modified where desirable. Although the dead-white background is the most usual, silhouettes look less hard, and consequently more artistic, when printed or stuck on pale cream-tinted paper. To make all complete, they should be placed in one of those old-fashioned ebony frames, now imitated in every detail and sold by most picture dealers. The new opaque, Johnson's Snow White, suggests itself here as the most efficient and least messy aid for blocking-out and after-spotting.

Flashlight Silhouettes

To make flashlight silhouettes, tack a sheet in a doorway or opening between two rooms and focus the subject in front of the sheet, about three feet away. If the sitter will hold a lighted taper behind the face, this can be

sharply focused. Place the flashlamp, or a small pile of powder, say, a spoonful, on a dustpan, about four feet away from the sheet, in the other room or passage. Open the lens and make the flash.

The simplicity of this method suggests its use as a profitable side line at fairs and bazars. Thus, fix a permanent background of white sheeting in front of a portable box arrangement resembling the familiar Punch and Judy show. Keep the flashlamp in this box, which should have a flap-covered opening behind to allow for recharging the lamp, and a flexible flue to carry off the smoke. Positions for lamp and sitter should be fixed to give the correct focus as soon as the subject is seated, and the exposure made, when ready, by means of a rubber bulb and tubing of convenient length or the use of a fuse.

Variations

A pleasing variety of this lighting is to use an old sheet as described, save that directly behind the subject's head a round hole, about two or three inches in diameter, is cut. Place the lamp directly behind this opening and ignite about ten grains of powder. This gives the profile lined by light with a halo about it, and is very effective. Another variety of the same effect is secured by using a dark ground pierced as described.

Firelight portraits, with very pleasing poses and light effects, are easily made by flashlight. Arrange the figure, or it may be a group, around the fireplace and focus carefully. When ready for exposure, an ordinary flashlight cartridge or flash-sheet placed and ignited in the empty grate will supply the light. In the case of a single portrait so made, see that the light itself does not come within the picture space. In the case of a group seated about the fireplace, see that one of the figures comes directly between the lens and the light.

In all flashlight work done at night, the usual lights of the room should be left untouched unless they happen to come within the field of view. This lessens the momentary shock when the flash is made, and helps the subject to preserve the natural, unconscious expression at the moment of exposure. For head-and-shoulder portraits the flashlamp should rarely be lower than seven

feet from the floor, although this will necessarily be regulated by the height of the subject and the style of lighting desired. For full-length figures the light should be higher, viz., eight or nine feet from the floor. The commonest fault in all amateur flashlight work is placing the light too low.

As a rough guide to the amount of powder required, the following quantities will usually be sufficient for a plate of normal rapidity (H & D 200) and the lens at *f*/8; at five feet from the subject, use 10 to 15 grains of powder; at ten feet distance, use 30 grains of powder. If the subject wears clothing light in color, or white, and the surroundings are not dark and heavy in tone or color, these quantities may be reduced by one-third.

Out-of-Doors All outdoors is the children's playground, and for that reason the best all-the-year-round studio wherein to make pictures of them, once they are able to run and play among themselves. Almost every difficulty, real or imaginary, met with in the studio or at home, vanishes under the open sky, and the work is pure fun. Happy the man or woman who can spend most of his or her days in it!

What was said about the two ways applies even more forcibly in outdoor than in indoor work. We may set ourselves to formal portraiture, large heads, half and full figures or groups, in the garden, on the porch, or in any shady spot afield. Or we can let fancy run free and make pictures of the children wherever we find them at their play, scheming our compositions so that the child or group is the chief interest or merely a part of the picture. The possibilities are illimitable, and our own skill is the deciding factor in our success.

Cameras The reflex camera is especially adapted for this outdoor work, because of the utter freedom it gives in following the subject, and also because we can include action or movement in our pictures, if this is desirable. With it one can be sure of the composition and focusing right up to the instant of exposure. But the reader with a hand camera and inter-lens shutter, with a ready knowledge of his equipment, need not worry

about his lack of a reflex, or the fact that his lens is only a simple rectilinear or meniscus. It is true that he will need a little more patience and resoucefulness than the reflex worker, and that he may be limited in the time of day and year when he can work. But, outside the obvious limitations of his tools, he can more than fulfil his desires.

Illumination

In working out-of-doors, we have a super-abundance of light, and have to learn how to control it rather than how to make the most of it. The best hours of the day are those before 10 A.M. and after 3 P.M. for all pictures not including movement; for these latter we will need the sunlight, unless we have an extra-rapid lens. Where the pictures are made near trees and in a bright light, we must exercise care to avoid scattered lights and shadows falling on the subject. In the open, we must avoid flatness and lack of relief or modeling caused by the widely diffused illumination. These things, of course, refer to deliberate portraiture out-of-doors. When we follow the other method of joining with the children at their games and making our exposures as the chance offers, we must take the light as we find it.

A Favorite Plan

An excellent plan to follow when a friend or patron desires outdoor portraits of a child, or portrait groups of two or three children, is to arrange to spend a few hours with them at their homes, or accompany them on an excursion to a nearby park, or into the country, or to the seashore on a favorable day. This method is followed by many home portraitists with complete success. It enables the photographer to get acquainted with his little sitters, and many picture-making opportunities will present themselves during the day which will give wholly pleasing results. The manipulative part of the day's work should, of course, be planned out beforehand so far as is possible, so that the pictures may be secured without fussy preliminaries when the favorable moment arises for an exposure. If the work is done in the garden or grounds surrounding the home, it will often be possible to utilize the domestic pets of the children, such as a pony, dogs, kittens, or

home toys, such as miniature trains or mechanical devices, to keep the children interested and amused while the work is being done. Charming pictures have been made of children in gardens, watching a snail crawl across the path, or a butterfly or bird upon a bush, or watching the reflections or ripples in a fountain basin, and so on indefinitely.

Locality

If the immediate surroundings of the home are too restricted in space or too formal in arrangement, as will often happen in our city life, there are always many delightful picture-making places in every suburb or country town which will give the desired setting for our picture-making. Choosing these spots beforehand by our intimate knowledge of the locality and its possibilities, the children will readily join in a photographic excursion which will be fruitful in pictorial results of the most desirable kind.

Surroundings; Accessories

If we have a stream or lake nearby and two or three boys under twelve years as subjects, the sailing of toy-boats and ships upon these home waters will afford the happiest sort of pictorial material. If we have to deal with young girls, then an outdoor tea-party or similar festival will provide equally good opportunities. There are few things in life more thoroughly enjoyable than an afternoon or a morning with two or three children and a camera in the open, whether it be around the home or farther afield. So far as the technicalities of the work are concerned, so long as we know something about minimum exposures with the lens and plate in use at the season in which we work, we need not bother except to follow the single rule—to give as long an exposure as we dare, in every instance. Of course, in the lighting of our pictures it will be wise to avoid too glaring an illumination or too decided contrasts of light and dark. Especially if the children are dressed in light colors, we must be careful to so illuminate the subject and so control the lighting as to preserve the softness and flexibility of the texture, of things—flesh, draperies, and so on. Generous exposure and careful development will best regulate this

detail. There is nothing more offensive than pictures of children which are under-exposed or over-developed; hard, stiff, and unyielding even to the smile.

At the Seashore

For those who take their holidays at the seashore the opportunities for successful picture making of children are innumerable. At the seashore, more than anywhere else I think, children are happy and full of fun and vigorous life. The sands and low-rolling surf, an odd wreck or boat upon the beach, and skies clouded so as to hide the sun, offer the most desirable foregrounds and backgrounds. Composition, especially the placing of the figure and the securing of pleasing light effects, becomes an absorbing pleasure in such circumstances where all the limitations peculiar to studio or home portraiture have vanished. In the morning, if the sun comes up over the sea, the most delightful effects are obtained by posing the little single figures against the light. As the sun goes down in the late afternoon, in the shadows and reflections as a wave recedes, or in the pools found along the beach, equally charming effects are easily obtained with the figures outlined in light against the darker background of sand and sea. At noon, when the sun is overhead, there are wonderful light-and-shadow effects to be had with skilful handling, and the children at play on the beach afford innumerable compositions of unusual beauty and variety.

Professional Portraiture

If we ask the average professional photographer to name the most profitable branch of his all-the-year-round work, he will unhesitatingly answer: Photographing children. And many claim and advertise that they make a specialty of children. Some go so far as to have "Baby Days." But, strange to tell, very few seem to think it worth while to study and prepare themselves for special proficiency in this most profitable line of work. Some years ago, Mr. E. B. Core established a studio for children only in New York. Despite his success, he had no competition as a specialist, and since he retired, a year or two ago, America is without a studio devoted exclusively to the making of pictures of children. There

is undoubtedly a profitable opening here in most of our larger cities for some man or woman with skill and resourcefulness. The chances of success would, of course, be made more certain by the undertaking, together with the studio work, of the photographing of children at home.

Expert Advice How shall the professional win larger success in child-portraiture? Mr. Core tells us that the principal factors which enter into the making of the successful photographer of children are good nature and patience. He adds: While a certain amount of firmness, as well as love, rules the home-life of the little ones, in the studio it must all be love and patience. Don't expect to make pleasing pictures of children if you are bored by their childish prattle. Few things on earth are sweeter than their bright, happy faces. Nothing more interesting than their description of the newest doll or the big brown dog at home. I love to hear them talk and always seek to draw them out, using sometimes a little story to help me. I try to have them feel that they are doing just what they want to do themselves. You can lead but seldom drive them. My aim is always to so entertain or amuse them that they either do not realize or are unconscious of the fact that I am photographing them. They frequently say, "Ain't I goin' to have my picture taken?" after I am all through, thinking that they have only been having a romp with me. Don't shove them out the moment the sitting is completed. For there are none so quick to detect insincerity, and none so quick to repay any affection you may show them. Further, your interest in the children finds a ready response in the mother's pocketbook.

Madame D'Ora, of Vienna, an example of whose charming work may be seen among the illustrations in this issue, tells us that she believes in letting the little ones play among themselves or with their toys, attempting no false positions or studied arrangements, but taking the pictorial opportunities as they come. Left to themselves, with the camera always ready at hand, they never fail to offer abundant opportunities for pictures full of grace and childish charm.

Mistakes Perhaps the most obvious mistake made by professionals in their portraiture of children lies in the lack of reverence and simplicity which marks their treatment of children as subjects. The influence of environment, the effect of the strangeness of the studio and its methods upon the child, are points which rarely receive much consideration, although they exercise a real and direct influence upon the result of the sitting. The beautiful reserve of childhood, the natural sensitiveness and dignity which restrain most children from any familiarity with strangers until there has come a mutual understanding, are things which the average professional recognizes only to brush aside as undesirable. His method, as my observation has told me, is to carry the child through the sitting on a wave of excitement. There is a feverish and noisy activity in all his dealings with the little ones, from the flurry of "fixing up" both children and the studio for the event to the end of the performance under the skylight. The shake-up in the studio, the hurried rearrangement of accessories, the exaggerated funniness of the operator, the anxiety of the mother or nurse accompanying the child, and the general hubbub, all combine to develop in the little sitter the very qualities which make a successful portrait the most remote of possibilities. What is the remedy? Granted for the moment that the photographer has a strong liking for children, and is willing to take the pains so essential to the best results, how shall he overcome the real difficulties created by the strangeness of the place and its people, and make pictures portraying his little visitors as they are in the familiar environment of home life?

Remedies A great deal may be accomplished by taking away from the studio methods all that emphasizes its unlikeness to home and its surroundings. Let special appointments be made for children's portraits wherever possible, and set apart a children's reception- or waiting-room for their sole use. Furnish this room in a simple but attractive way with pictures of children, furniture suitable for juvenile uses, a few toys, animals, and a

simple game or two to beguile the time of waiting. A large music-box, set into the wall as a fixture, will often prove itself a potent charm with timid or obstinate children. That the room should be clean, bright, and sunny, cool in summer, and warm in winter, goes without saying. The aim in all this, of course, is to put the child at its ease, and to overcome any feeling of constraint or shyness. The photographer should meet his little visitors in this room and, in a few minutes or after a half hour's wooing, perhaps, become acquainted with the general characteristics of his subject before the sitting begins. Those who accompany the children should be warned, if needs be, not to discuss the sitting, or to instruct their charges concerning their behavior, or bother them with too much preparation. Everything else being favorable, the children's brief stay in such a room cannot but have a good effect on the afterwork. It should, indeed, convey the impression that the photographer's studio is almost as nice a place as the familiar play-room at home.

In the Studio Meanwhile all the preparations necessary in the studio should have been completed, so that when the child comes under the skylight, the place is quiet and ready for the sitting. The assistant should be well trained to play his or her part in winning and holding the interest of the sitter. Wherever possible, *all* friends and relatives should be kept out of the studio during the sitting, but most often it will be needful (essential with young children) to permit a single helper to accompany the child.

In the general handling of children, the photographer must be guided by his quick perception of the character of the child with whom he has to deal. Some children are easily excitable, and care must be taken not to rouse them overmuch; others are retiring and lacking in animation, for one cause or another. These latter may be skilfully interested by the use of a little diplomacy. The photographer is usually a good judge of character, acquiring the habit unconsciously in his daily work, but he will need all his knowledge of human nature for successful work with children. Thus he

should know how to tell the sick child from one that is well, the peevish, fretful, nervous child from one laboring under temporary timidity. Some children require a little "fuss" before they will be "drawn out;" with others quietness is the easiest way to win; and some are best left severely alone. A display of noise and bustle is the common blunder, and the lavish use of novelties of one sort or another may also be mentioned as requiring restraint. One thing is certain, if friends or relatives are permitted to be present at the sitting, they should not be allowed to interfere with or instruct the child. In dealing with very timid or young children the mother or friend may advantageously help in any physical handling of the child—this detail being one to which many children are strangely sensitive; but her help should be given with eye and hand, rather than by word of mouth. In other words, the sitting should be as far as possible a matter between the photographer and his subject, free from outside interruption or interference by others.

Babies

With very young children, difficulty will be experienced in getting their attention directed to any one spot for the moment needed for exposure. The best course to follow in such cases is to get the focus, put in the plate ready for exposure, and then, in absolute quietness, gently tap the floor. This will generally attract the attention of the child, without alarming it or causing movement, and the opportunity for exposure is gained. With older children whose attention wanders from one thing to another without resting on any one thing long enough for our purpose, the undemonstrative recital of a childish tale will often secure the degree of repose necessary. The vivacious child, of course, can be managed by being "let into the game," and impressed with the feeling that the success of the affair rests upon him. Or we may busy our subjects with some simple occupation, picture-book or toy, and at the desired moment get their attention for the exposure. Sometimes young children will persist in making "funny mouths," especially when the little teeth are coming. This can be overcome in part by touching the tongue

with a small pinch of salt, which causes the child to close its mouth for a moment, during which the exposure should be made.

There is a common desire among mothers for a picture of baby smiling. Don't indulge it without an attempt at a second picture without the smile. A smile is pleasing at a first glance, but one wearies of it in a picture, where it cannot change. Babies have as many moods as older folk, and are interesting in every mood, but the smiling baby does not wear well. Get the child interested, listening, looking for something or busy with its toes, and you will be just as gratefully remembered as if you had caught the smile.

As far as posing is concerned, the less said the better. Children from one to eight years are graceful in every move, that is, in free and spontaneous movement. From eight to fourteen years there is a little awkwardness, and simple poses will be most succesful. With girls the three-quarter or full length figure may be attempted; with boys the full figure should generally be avoided. But there are exceptions always. For my part, I prefer the method of letting the children loose in the studio, keeping them interested, and using a plate at every opportunity. This "wastes" plates, but insures variety of pose and expression, absolute spontaneity, and now and again a picture which could not be obtained by a hundred deliberate poses. Some photographers provide a movable platform—which moves easily and noiselessly—and many delightful pictures of children have been secured by the aid of this device between "rides" and "talks." This method, of course, is in keeping with "home" methods.

Groups

Where two or three children of the same family are to be photographed together, many pleasing combinations may be had by interlocking the figures in such a way as to secure unity, and yet keeping a desirable degree of separation in the figures. I have seen a clever example of this, offering a suggestion not yet made common. A group of four children—three girls and a boy—was arranged so as to display an oblique line of heads in profile, with the figures intertwined here and there by

linking the arms of two of the children. The balance of the upper portion of the composition was secured by lettering the children's names in the upper left hand of the background, while the lower portion of the picture was held together by the lines and masses of the draperies.

In dealing with babies (clothed) care is needed to see that the child is not lost in a mass of white linen. It is usually a difficult thing to get a picture of a young baby showing the whole of the face and hands or feet because of the superabundance of clothing *and* ribbons. But it can be done by patiently watching for the right moment. With babies minus any clothing we must strive for a pleasing outline, avoiding unsightly creases over the abdomen, etc. The full figure of a child, without clothing, is a favorite style with some mothers, but is seldom beautiful and, I am glad to say, is going out of favor. Such pictures are often a source of embarrassment and vexation later on. The half-figure is generally preferable.

Technical Details

Very little needs to be said about the skylight and technical equipment, so far as professional work is concerned. The ordinary studio camera, with its rapid portrait lens and an abundant supply of plate holders loaded with rapid plates, with some means of controlling the light, are all we require. In his home portraiture, the professional will do well to follow the suggestions given by the Cadbys, and to combine with his methods as much as possible of the freedom and flexibility characteristic of the methods of the amateur.

Edward H. Weston

Mr. Edward H. Weston, of whose clever work with children I am able to give an example among our illustrations, gives his methods in a few words. I quote:

For a camera I prefer [the simplest, most inconspicuous obtainable. Some studio outfits are enough to frighten a 'grown-up' with their artillery-like appearance. My camera is a 6½ x 8½ view holding a large lens-board. The lens is a twelve-inch-focus portrait-lens, working at *f*/5, fitted with a between-the-lens shutter, allowing only bulb exposures. Now this shutter has a decided click when opening and closing, but I

like it, for 'when I hear the shutter click I know I have it,' and I have a feeling that I can make a quicker exposure using it than with one of the air-cushioned silent shutters, such as I prefer to use on self-conscious 'grown-ups.' Using only the fastest plates and a wide-open light and lens, the quickest bulb exposure I can make is sufficient time, and, unless the subjects are already moving at the time of squeezing the bulb, a blurred image is a rarity. The noise of the shutter will not cause them to move quickly enough, if indeed they pay any attention to it in the interest of the moment.

Personally, I always dislike to see a child portrait taken against a dead black ground, as it appears too harsh and dismal for the dainty little being. Using a background of white canvas, one may procure any shade from white to very nearly black by turning it to and from the source of light. The soft, sketchy, lighter effects appeal to me as being more suitable for the portrayal of child-life. Window lightings open the way to exercise originality, to put a personal touch into one's work. A little study of the light coming from various windows and doors in your studio will add many different and beautiful effects to your repertory of lightings. Try something new with every sitting. It wakes one up.

As mentioned before, I use only the fastest plates, and these are invariably tank-developed, thus bringing out all there is in a necessarily short exposure.

The Mercury-Vapor Light

The increasing use of artificial light in portraiture deserves a word of mention here, as peculiarly applicable to the photographing of children. I refer particularly to the use of the mercury-vapor light introduced by the Cooper-Hewitt Company, to my mind the most satisfactory form of artificial lighting at present available in photography. The mercury-vapor lamp, now used by many portraitists exclusively, provides an ideal light for the studio and for home portraiture. It gives a brilliant but soft illumination, always dependable and uniform and doing all that daylight will do, with the big advantage of being always controllable and always at hand when and where we want it. In other

words, it gives us ideal daylight conditions in any place and at any time. More important, its actinic quality permits of extremely short exposures, in which it may be used in combination with daylight to great advantage.

The mercury-vapor light will give us the most desirable sort of silhouette portraits, and, in ordinary lightings, by a skilful adjustment of subject, lamp, and a light background, we can get charming shadow outlines of the childish profiles, adding thereby new life and interest to the picture.

A special form of this lamp is available for home portraiture. It is adjusted upon a tripod to give the conventional illuminating angle of 45 degrees, and connected with any handy electric-lamp socket. A red or pinkish reflector or screen is used between the light and the subject. With such a lamp, the exposure will vary according to distance between lamp and subject, averaging two or three seconds for subjects in light clothing. When this lamp is more widely known, I am confident that few photographers of children will try to get along without it.

Finis

Here our adventure ends. I am sorry that I cannot advise the reader where he may supplement his knowledge of this special field, as there are no books on the subject. But I can advise him to study the innumerable pictures of children included in the reproductions of paintings now so readily obtainable, from which many useful hints and suggestions may be had for use in practice.

Notes and Comment

The Tree-pod is an ingenious device which replaces the tripod as a means of supporting the camera from a tree or other convenient wooden post. It has two metal prongs which open like scissors, while a third prong holds the camera by the usual socket and extends rigidly to the tree or post. The camera is thus held vertical, rigid, at a distance of about nine inches from the upright to which it is attached. The Treepod is made of steel, nickel-plated, and folds into the vest pocket. It sells at $1.25. Northern Photo Supply Co., Minneapolis, Minn.

Our readers are reminded that the Kodak Advertising Competition, with $3,000 in cash prizes, closes at Rochester, N. Y., November 1, next. The ten prizes offered, ranging from $100 to $1,000, are for pictures illustrating Kodak advertising. Get the descriptive circular at your dealers and enter the competition as a trial of your skill. The work you do will benefit you, whether you win a prize or not.

A Precision Shutter Testing Instrument, by P. G. Nutting, Ph.D., of the Kodak Research Laboratory, Rochester, N. Y., is the title of an unusually interesting and valuable paper published in the July number of "The Photographic Journal of America." English readers will find it in the June issue of The Royal Photographic Society's *Journal*.

Monomet is the name of a British developer which replaces metol, having equal activity but giving more density. The sole American agency for monomet has been secured by Ansco Company, Binghamton, N. Y., to whom inquiries should be addressed.

The agencies which make a business of selling photographs to the illustrated press of Great Britain are so numerous that they have banded together to protect their interests as the Proprietors' Association of Press Photographic Agencies, with offices at 46 Fleet St., London, E. C. American photographers seeking to place their photographs in British papers should first communicate with this Association. The Associated Newspapers, Ltd., has put in a tender to the British Government, offering a minimum payment of $25,000 and half profits, for the exclusive privilege of making official photographs of the war in France and Flanders. The tender has been acccepted by the government.

England has a Nature Photographic Society, with annual exhibitions, illustrating the application of photography to biological investigation. The secretary of the Society may be addressed at 26 Charing Cross Road, London.

FRESH OR STALE CHEMICALS

Writing in "Photography," A. Goodwin gives the following useful table of the "keeping" capacity of the chemicals most generally used in photography.

The three columns show the probability that the substance although, say, a year or more old, will still be in working order. Column I, headed "Unprotected," refers to the substance kept in a loosely covered bottle, jar, or (if a solid) in a paper packet. Column II, "Protected," applies if the chemical is in the sealed bottle as issued by the maker, or is in a well-corked or well-stoppered bottle, but not necessarily sealed up. Column III deals with the keeping property of the substance in solution, not necessarily in a plain solution in water, but in solutions of the kind used in photography when there may be preservatives or other compounds present. In the case of liquids, Columns I and II apply; but with the necessary modification as to keeping in paper, etc. Column III then deals with the liquids diluted.

Name of Chemical.	I. Unprotected.	II. Protected.	III. In Solution.
Acetic acid	Bad	Good	Good
Alcohol	Bad	Good	Good
Alum	Good	Good	Good
Amidol	Bad	Good	Bad
Ammonia	Bad	Good	Good
Ammonium bichromate	Good	Good	Good
Ammonium bromide	Bad	Good	Good
Ammonium carbonate	Bad	Doubtful	Doubtful
Ammonium sulphide	Bad	Doubtful	Bad
Ammonium sulphocyanide	Bad	Good	Good
Azol	Bad	Good	Bad
Borax	Good	Good	Good
Certinal	Bad	Good	Bad
Chrome alum	Good	Good	Good
Citric acid	Good	Good	Good
Copper sulphate	Good	Good	Good
Eikonogen	Bad	Good	Doubtful
Ferric chloride	Bad	Good	Good
Ferrous sulphate	Bad	Good	Good
Glycin	Bad	Good	Doubtful
Gold chloride	Bad	Good	Good
Hydrochloric acid	Bad	Good	Good
Hydrokinone	Doubtful	Good	Bad
Hypo	Good	Good	Good
Iodine	Bad	Good	Good
Lead acetate	Good	Good	Good
Mercuric chloride	Good	Good	Good
Metol	Bad	Good	Bad
Nitric acid	Bad	Good	Good
Ortol	Bad	Good	Bad
Potash, Caustic	Bad	Doubtful	Bad
Potassium bichromate	Good	Good	Good
Potassium bromide	Good	Good	Good
Potassium carbonate	Bad	Good	Good
Potassium chloroplatinite	Bad	Good	Good
Potassium cyanide	Bad	Good	Bad
Potassium ferricyanide	Doubtful	Good	Doubtful
Potassium iodide	Bad	Good	Good
Potassium metabisulphite	Bad	Good	Doubtful
Potassium oxalate	Good	Good	Good
Potassium permanganate	Good	Good	Doubtful
Pyro	Doubtful	Good	Doubtful
Quinol (see Hydrokinone)	—	—	—
Rodinal	Bad	Good	Bad
Silver nitrate	Doubtful	Good	Good
Soda, Caustic	Bad	Doubtful	Bad
Sodium carbonate	Bad	Good	Good
Sodium citrate	Bad	Good	Good
Sodium thisulphate (see Hypo)	—	—	—
Sodium sulphide	Bad	Good	Doubtful
Sodium sulphite	Bad	Good	Bad
Sulphuric acid	Bad	Good	Good
Sulphurous acid	Bad	Good	Bad
Uranium nitrate	Bad	Good	Good

Books and Prints

"The Portrait Studio." By "Practicus." 40 pp.; diagrams; paper covers, 25 cents. London. Hy. Greenwood & Co.

Since THE PHOTO-MINIATURE No. 50: "Studio Construction," is out of print, the handbook here noticed is the only work in English dealing with its subject. Like other contributions by our friend "Practicus," the book is intensely practical in its information, and a reliable guide in the questions of size, design, equipment, and the management of photographic studios. The diagrams illustrate the principal styles of studio lights and the smaller details, such as light-gathering glass, portable reflectors and light-controllers, are all carefully considered.

"The Photography of Colored Objects," second edition, edited by Dr. C. E. Kenneth Mees. 118 pp. profusely illustrated. 50 cents. Eastman Kodak Company, Rochester, N. Y.

We are glad to see a new and carefully revised edition of this cleverly written handbook which, on its first appearance a few years ago, we pronounced one of the best of all the books published for photographers. It gives the clearest explanation of color correct or orthochromatic photography within our knowledge, and then shows the practical application of this teaching to everyday photographic work. For the portraitist and outdoor worker, and especially for those whose work brings up difficult problems in color reproduction, it offers definite and constructive information worth many times its cost. In this new edition the former supplementary volume on "Ortho Color Filters" is combined with the original handbook, so that the two books are now available at the price formerly asked for one above.

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Optical Notions for Photographers

In photography, as in any other craft, we cannot know too much of first principles. For one thing, the study of them is a fine education of the mind; for another, we are prevented from making stupid mistakes—from doing things we should never dream of doing if we perceived clearly the broad elementary facts which lie at the bottom of the processes or apparatus we use. And still another reason is the entrance which we thereby gain to other and wider fields of knowledge, the boundaries of which no man can define since they are continually being extended as unknown facts of Nature become known.

I cannot pretend to escort the reader very far in the most fascinating field of light, yet I believe the adventure will be found altogether interesting. Certainly it will not be without profit in every-day photographic work, without which assurance I should hardly care to ask the reader to make a journey somewhat off the beaten track of these monographs. But I can promise that our excursion, as I have planned it, will bring us into contact with facts which have to do with everyday photography, and that at the end we shall be in the happy frame of mind of, say, some business man who has made a pleasure-trip over half a continent and has brought back a sheaf of orders into the bargain.

So much for the dual purpose of these pages. Now let me say a word of their subject matter. Photography, as we all know, belongs to the regions of both chemistry and that branch of physics concerned with light. In a narrow sense it is based upon the chemical action of light. But in making photographs we carry out many chemical operations which have nothing whatever to do with light, and equally we have occasion to use and control light altogether without concern for its chemical action. Readers of THE PHOTO-MINIATURE, Nos. 18 and 149 will have gained some insight into the chemical principles and processes, but I cannot recall any photographic manual in which an attempt has been made to explain in plain English the elementary properties of light. These are of prime importance, however, in almost every branch of photography. It is true we have books on lenses, such as THE PHOTO-MINIATURE, Nos. 1, 36, 79, and 140, but they deal only with the part played by light and the lens in forming the image on the plate or film. In the present monograph, written and illustrated with painstaking and enthusiastic care by Mr. George E. Brown, we get back to first principles. Moreover it seeks to deal with real things, whereas authors of treatises on optics almost habitually write of things which happen only in books, passing over many things which happen in practice, solely for the reason, so it would seem, that they cannot be expressed except in formulæ which few can understand.—EDITOR.

Sources of Light

From whatever source it comes, the unclouded sun, a dull sky, or any flame or lamp, light follows the same laws. Some of its properties vary according to its origin—these are chiefly its color and degree of diffusion—but essentially it is the same and behaves in the same way in the changes it undergoes by reflection and absorption, on passing through transparent or semi-transparent substances, and when subjected to control in this or that optical instrument.

Its behavior is the same for the reason that light, however produced, has, on good grounds, been judged to be a wave-motion on an ultra-miscroscopic scale,

not of the air but of a far finer medium (ether), assumed to exist and to pervade all space and every substance. In other words, light is conceived to consist of innumerable minute wavelets measuring 40,000 to 60,000 to the inch, and moving in this elastic ether. The ether as a whole does not move, but extraordinarily minute movements up and down, sideways, etc., in it create the wavelets which traverse it and produce the effect of light.

Unfortunately it is not possible in this monograph to treat the facts of light in the terms of this wave-theory. To do so would entail diagrams beyond our space and mathematics probably in excess of the reader's inclination. But light can be so treated, as it is, for example, in Prof. R. W. Wood's magnificent book "Physical Optics," in which, scattered among stiff mathematics, you will find a host of experiments, including many which come from the author's fondness for photography. But though we leave the wave-theory for the most part on one side as a vehicle of explanation, let it not be thought that it is thereby relegated to the category of doubtful things. Although these minute undulations of an imagined ether are outside human ken, so much is known of them that they rank with steam or the electric current among the things which admittedly exist even though they cannot be seen and handled.

But to return. Here we shall seek to recognize the points of difference and resemblance which characterize light from different sources, and shall endeavor to gain our knowledge by way of the use we make of light of one kind or another in practical photography.

Light in Straight Lines

One feature, common to light from every source, is that it travels in straight lines. It takes a straight course which can be modified only by doing something which will put it on a second straight-line path making an angle with the first. As a matter of daily observation we know that rays of light do not follow a curved course like a stream of street traffic or a projectile in flight. All optical instruments, lenses, telescopes, and sextants are based on that fact, and the science of geometrical

optics is concerned with the study of light on this basis as distinguished from physical optics which starts with light as a minute wave-motion and arrives at the same laws by a different train of reasoning. Here we shall follow the former plan since it lends itself much better to the explanation of the elements of the subject.

Parallax

One of the consequences which follows immediately from the fact of the straight-line course of light is that the position of one object with regard to another, placed somewhat in front of it, changes with the position of one's eye. Apparent shift of this kind is called parallax, and is the cause of various errors in observation, insomuch that the term is most frequently met with in connection with mistakes due to rays reaching the eye obliquely instead of "square-on." A common example is the setting of the pointer on the graduated focusing-scale of a hand-camera. In Fig. 1 the distance of the pointer A above the scale is exaggerated. The ray of light proceeding directly upward from the mark B and just grazing the pointer, meets the eye when it is placed as it should be, exactly overhead at D. But if the eye is placed to one side or the other, as at E, it is the ray from C which meets it. The mistake is one of parallax and is liable to be more serious the greater the space between the pointer and the scale.

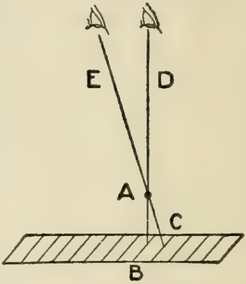

Fig. 1

Parallax in Color Processes

This parallax error creeps in in other ways, for example, in color photography by a process such as the Paget where a plate consisting of minute color elements is united to a positive transparency obtained from a negative made through a similar color-screen. I would refer the reader to The Photo-Miniature, No. 147, "Color Photography." Fig. 2 shows what happens in the case, for example, of a green patch in the picture produced by blocking out the

blue and red element by the deposit on the diapositive. So long as rays pass straight through the two films (Fig. 2) there is no disturbance, but if the eye is placed so that rays passing obliquely reach it there is bound to be falsification of the colors due to the rays passing

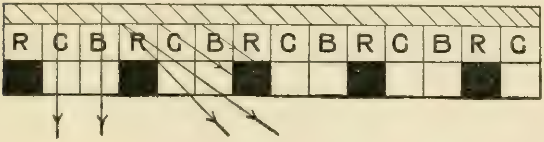

FIG. 2

through parts of adjoining color elements. This effect arises to some extent with color film and diapositive in one owing to the thickness of each layer, but it is more pronounced when the two are separate glass plates since it is practically impossible to bring the two surfaces into absolute contact. My diagram shows why the latter kind of transparencies show false colors unless means can be taken, as when projecting them in a stereopticon, to cause the light to pass through them at right angles to the surface. Parallax, it should be added, is not always a troublesome phenomenon: some years ago Mr. F. E. Ives applied it very ingeniously to making stereoscopic or relief photographs requiring no viewing instrument for the exhibition of their illusion of relief.

Illumination

A further consequence of the straight-line path of light-rays is the rule of relative intensity of illumination of surfaces at different distances from a source of light of small area, a matter of every-day moment in making contact prints on development or gaslight papers. In Fig. 3 the lines represent the extreme rays falling on the small square surface A from the candle. Imagine this square taken away and the light to fall on a surface B at twice the distance. It is clear that the area of this surface is four times that of the square A, and as the volume of light is the same—the second surface does not receive any more rays from the candle than

the first square did—the intensity of illumination is one-fourth. Similarly, at three times the distance the intensity of illumination at every point of C is one-ninth and at four times the distance one-sixteenth. In other words, a printing-paper which, under a negative, requires 1 second exposure at A, will require 4, 9, or 16 seconds' exposure if placed at B, C, or D, respectively.

Inverse-Square Law

This is the law or rule of inverse squares so often referred to in books about enlarging, viz., that the intensity of illumination varies inversely as the square of the distance from a small source of light, that is to say that photographic exposures will vary not inversely but directly as the square of the distance from the light.

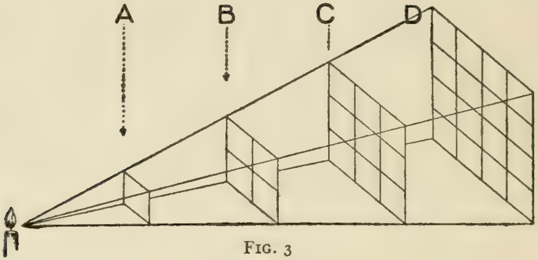

FIG. 3

There is no need to be frightened by the term "square." It is simply the distance multiplied by itself and written, for short, distance^2 e.g., 2^2, 3^2, 4^2, $=4$, 9, and 16 respectively. It means that if the exposure at 2 feet from the light source is 6 seconds, that at 5 feet will require to be $6 \times 5 \times 5 \div 2 \div 2 = 37\frac{1}{2}$ seconds.

Yet Beware!

But look again at Fig. 3 and you will notice something about it. The light proceeds from a point. The law holds good only when the light emanates from a minute source. But usually the light is not very small. It is generally a lamp-flame, gas-mantle or electric bulb of size very likely as much as a quarter the distance of the printing-frame from it.

If that is so, the inverse-squares law no longer holds

good, and it is not possible to say exactly how the intensity of illumination at 2, 3, or 4 feet distance compares with that at 1 foot. The reason for this is that the rays from every point in such a light-source spread out like those from a bit of the candle flame in Fig. 3. Instead of one set of rays all diverging from one point, you have innumerable sets diverging in all directions from the light-source, the rays of one set overlapping those of another when they fall on any surface a little way off.

In these circumstances it is not possible to state a general rule for the falling off in the intensity of illumination: any rule depends on the size and shape of the light-source and its distance from the surface. Also the illumination is usually not uniform unless the source of light is as large as, or larger than, the surface to be illuminated. As regards the lights we have mentioned, the only rough idea I can give for distances up to, say, 3 feet from the light is that the illumination is inversely proportional not to the square of the distance but to the distance alone. In other words the exposure required at 2 feet and 3 feet will be twice and three times that at 1 foot, not four times and nine times.

Where "Square" Rule is Null

But even when the source of light is almost a point, e.g., an electric arc, the inverse-square rule may cease to apply. Not theoretically, but practically. Suppose your light is a long way off, say 30 feet. Then a position a foot or two further away will make relatively very little difference. At 33 feet the exposure will be only one-fifth more than that at 30 feet since the squares of these two distances are 900 and 1087, and are in the proportion of practically 100: 120.

A difference of 20 per cent in the exposure of printing-papers is not enough to have any appreciable effect. If you think, you will realize that at such considerable distance from a small source of light, the rays, if one considers only a short length of their path, are almost parallel. Therefore, within the limits of this length the illumination does not vary materially. If the light-source is at an immense distance the light-

rays are to all intents and purposes parallel. If they are parallel, our inverse-square law does not apply at all and the intensity of illumination is the same whatever the distance, except in so far as the light may be absorbed in its passage through the air.

The use of a lens which renders parallel the diverging rays from a source of light is the method employed to secure a beam which illuminates as strongly at 30 or 50 feet as it does at 2 feet. This is the system of the light which, from the gallery of the vaudeville hall, follows the star lady on the stage. The rays if not perfectly parallel are very slightly divergent. The lenses in these theatrical light-boxes are of curvature to yield a cone of rays of very narrow angle. Over a short distance the rays are fairly parallel.

All-round Illumination

It must be remembered that in the foregoing paragraphs we have considered only the rays coming in one direction (horizontally) from a source of light. But most light-sources emit rays in many directions—toward an imaginary sphere or globe at the center of which the light is supposed to be. The illumination from any light-source, except supportless incandescent globes like the sun, varies very greatly in different parts of this imaginary sphere, and lamp-makers now measure the distribution of light by their bulbs or mantles and can supply charts or figures showing exactly what it is. This is too wide a subject to pursue further—the reader must refer to text-books on illumination—but it is not without its practical importance.

For example: The electric bulbs which are fitted into the printing- and enlarging-boxes now so much used will behave very differently as regards the light they send to the negative, according to the way they are placed. There will always be one part of the imaginary sphere surrounding the lamp which gets the best illumination, and the lamps should be mounted so that the negative comes in this portion of the spherical field. A year or two ago, a lamp specially designed for emitting its rays chiefly in the direction of the end of the bulb was placed on the market. The filament

extended gridiron fashion across the bulb instead of lengthways as usually. I found that exposures were one-fourth those required with a lamp of the usual pattern and equal candle-power also placed with the tip pointing toward the negative. Obviously the ordinary pattern of bulb should be used with its filaments as nearly as may be parallel with the negative, yet one often sees printing-boxes fitted with the usual lamps, end on, in disregard of the fact that electric bulbs are not miniature suns but scatter their illumination in different directions very irregularly.

Light at Second-Hand

So far we have been concerned with the distribution of light directly from its source. Now we must come to consider what happens when light falls on different objects. These happenings are various. There is reflection, with which we are familiar enough, and absorption, which we are apt to overlook. In passing through substances, light also undergoes other changes which play a very important part in photography. The behavior of light in these various ways will again be found to bear directly upon the processes and appliances employed in making negatives and prints.

Reflection

Reflection of light takes place in various ways according as the reflector is a polished or matt surface, is opaque or transparent. The reflective action differs, first as regards the quantity or proportion of light reflected, and second as regards the direction (or directions) which the reflected rays take. When light falls upon any body three things can and do happen. Some of the light is reflected, some is absorbed and disappears, and some, if the body is more or less transparent, passes through. In looking more closely into these matters we will take first the action of flat polished reflectors since this differs radically from that of matt or rough surfaces such as paper or walls.

Regular Reflection

A substance of flat polished surface, such as plain glass, burnished metal, or glass with metal deposited on it, reflects light in a definite way, referred to in the text-books as "regular" or "specular" reflection. If the

light strikes the reflector squarely, at right angles to the surface, it is reflected straight back again along the path by which it came. But if the light falls on the surface at any other angle than a right angle, each of the rays which make up the total volume is reflected at the point where it impinges on the surface according to an invariable rule illustrated in Fig. 4. A ray from A meets the surface at B. From B imagine a line, BE, drawn perpendicular to the surface. Then the distance of the reflected ray BD is known from two facts: (1) It lies in the same "plane" (that is an imaginary thin surface) as AB and BE and (2) it is inclined to the perpendicular BE to the same extent as is AB. All reflection from polished surfaces follows the two-in-one rule, which is expressed by saying that the angle of incidence, ABE, is always equal to the angle of reflection, EBD.

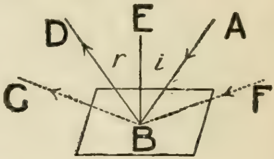

FIG. 4

But remember that that alone does not fully describe the law unless it is understood that the reflected ray lies always in the same plane as the incident ray. If the nature of light did not compel it to remain strictly in the same plane—it is a necessary consequence of wave-motion—it could strike off in any of a thousand different directions all angled to BE as AB is, and there would be no such thing as regular reflection. As it is, the reflected ray has always this definite relation to the original ray whatever the first direction of the latter. If it is more oblique, as shown by the dotted line FB, the reflected ray is BG; the angle FBE is equal to the angle EBG.

An Illustration

A homely example will remind you that this definite law of reflection is true. On a day of brilliant sunshine you will sometimes see flash out a patch of intense light from a distant window or polished face of a clock as you happen to come into a certain position. You have only to move a little away for the effect to vanish. You came into the path of light traversed from the

reflector which anywhere else at such a distance is invisible. If all objects reflected light only and solely in this way we should be able to perceive things only from certain definite positions, but, as we shall see directly, light is reflected in another way which permits of objects being viewed wherever we may be.

Mirrors

Now what is the consequence of this definite and rigid law of reflection? It is that a polished surface reflects light not merely in any jumbled fashion but a ray for every ray which falls upon it. One might think from this that if you held up a mirror before any scene or object you could reflect an image of the latter onto a screen. But a mirror does not *form* an image in this way. What it does do is to *show* an image which you can see or photograph "in the mirror" though you cannot reflect it onto another surface. If we take the trouble to consider the reason for this it will serve incidentally to make clear some of the points connected with the action of the photographic lens.

How a Mirror Acts

Figure 5 is a diagram explaining how the bright picture or reflection which we see "in a mirror" is formed. MM is the mirror and A some minute object facing the mirror-surface. What is happening when we look at the mirror and see the object A apparently behind MM? Clearly it can only be that the rays from A are reflected back by the mirror to our eye wherever it may happen to be, say at E. We know that an object, whatever it is, emits light in all directions. It will be sufficient to see what happens to two of them, AB and AC,

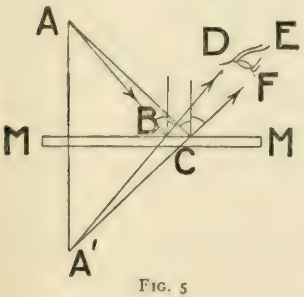

Fig. 5

which strike the mirror at B and C. As we have just learnt, each is reflected so that the angles which the reflected rays make with imaginary perpendiculars are

respectively equal to angles which the direct rays make with the perpendiculars. By drawing lines on this basis you get the reflected rays BD and CF. You notice that they are not parallel since the ray AC is more oblique than AB. Now lay a straight edge along each in turn and continue each until they meet. If you have done your drawing of lines and angles correctly you will find that the point A^1 where the continued lines meet is exactly opposite A, and that A and A^1 are at the same distance from the reflecting surface. In other words, the rays which we know reach us from A by reflection at B and C appear to come from A^1. Though the rays from A^1 have no existence the effect on the eye is as though they did exist. They are what opticians call *virtual.* It is as though the object A had been transferred to A^1, and that applies to every other minute object forming a scene near or distant and to any position of the eye from which the mirror can be seen. The image (virtual) is as far behind the mirror as the object is in front of it. This is the principle of the old dodge of judging the thickness of a mirror silvered on the back by laying a coin on the glass surface and estimating by eye the distance between it and its reflection. This distance of course is half the thickness of the glass.

Not a Real Image

From the foregoing it will be clear that a mirror does not form an image in the sense that a photographic lens does. All it does is to form an optical same-size illusory reproduction of an object in a plane which seems to be behind the mirror. It forwards the rays to the eye exactly as they would come from the original scene—except in one respect referred to in the next paragraph. It does nothing to bring to a focus or point all the rays which come from every point in an object as a lens does in forming a real image—our eyes do that when we look at a real thing or a mirror-image—but it must not be forgotten that a mirror, if interposed in the path of rays from a lens, reflects them, also, according to the definite law of page 374 (Fig. 4). It can reflect the rays forming a real image and is widely used for that purpose in optical instruments.

Reversal by Mirror

But the image we see in a mirror differs from the original object in one important respect. It is reversed as regards right and left. That this must be so will be clear if I repeat the diagram Fig. 5 in a rather more elaborate way, show the formation of the mirror-image not of a point but of an object of definite shape, e.g., a line AB. To construct the image it is sufficient to apply the previous method to the points A and B. The reader will see that it is exactly that of Fig. 5. It shows why, when viewing the image, A¹ is on the right and B¹ on the left, whereas, when taking a front view of the original object, A is on the left and B on the right. This action of the mirror is exerted equally when it is applied to the rays from a lens, causing an image or a negative to be reversed right for left and *vice versa*.

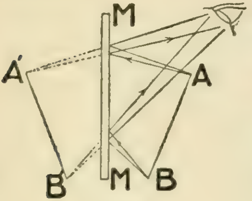

FIG. 6

Unwanted Reflection

Well, now what of the application of these properties of a polished reflecting surface in practical photography? They are not far to seek. I have space only for two or three, the purpose of this manual being to explain principles to be applied by the reader himself. But one or two examples are worth while by way of showing that the principles must and do govern all practical work. Take for instance the photographing of a painting, the glass covering of which, or even the varnished surface itself, acts more or less perfectly as a mirror. Reflections are in fact the bane of those engaged in taking photographs of paintings in public galleries where the conditions of lighting usually make it difficult to avoid them. What are those conditions? The painting is usually placed near to a window or is photographed in its permanent position on the wall. In either case, it is almost always exposed to rays from the outside sky or from light parts of the gallery. These rays are reflected in directions which depend upon the angle at which

they fall upon the painting or its protective glass. Our law of page 374 (Fig. 4). According to the particular circumstances a large or small proportion of them form the whole or part only of the picture, impinge on the lens, and produce excessive action on the plate. The effect is the unsightly glare to be noticed in many photographic copies of paintings.

A knowledge of the law of reflection enables the photographer frequently to avoid this defect altogether, e.g., by covering up part of the window, by erecting a screen to cut out the rays, or more simply still by slightly angling the painting to the camera or *vice versa*, so that the reflected rays do not travel to the lens. In cases where the light which is thus harmfully reflected to the lens comes from behind the camera—to one side or the other—an old device is to erect a large black curtain just in front of the camera with a division in it for the lens to poke through. In order to have this curtain of the most advantageous size, Mr. Cameron-Swan, a leading professional photographer of paintings, calculates its size in accordance with the law of reflection from a polished surface and finds that a screen a little more than twice the linear dimensions of the picture to be copied, placed just in front of the camera, serves to cut out all the rays from the rear which can be reflected into the lens. Anything larger than this only intercepts light which might usefully (not harmfully) illuminate the painting.

Useful Reflection

A different requirement arises in cases where we want to reflect all the light we can. For example, a mirror is often used to direct the light from the sky through a negative which is being enlarged with an apparatus evolved from the worker's camera. The window of a room is closed up with the exception of a space where the negative is placed and the mirror (outside) is angled at 45°. A similar plan is followed in printing-boxes, using gas as the illuminant, the light being reflected upward through the negative by a mirror again at an angle of 45°. In such cases the law of page 374 tells us at what angle to set the mirror, but it requires to be remembered that the regular reflection

from a polished surface may really be less effective than a matt reflector like paper which, as we shall see directly, acts in a different way. This is because the polished surface is called upon to reflect rays which reach it at all degrees of angle. Hence it will reflect many rays in a direction along which they never reach the negative. Fig. 7 illustrates this point, NN being the negative and the lines showing the subsequent paths of rays falling on the mirror MM at different angles.

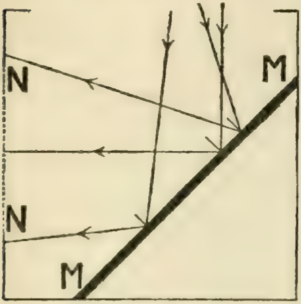

FIG. 7

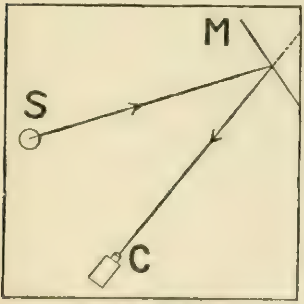

FIG. 8

Generally speaking, a polished surface is less efficient and in other ways less suitable than one of matt surface as a means of illumination unless all the rays which fall upon it are parallel. On the other hand, it is hardly necessary to point out that a reflector for use in altering the course of rays from a lens requires to be of the highest polish and optically flat. If it is not, the image will suffer in brilliance and definition, respectively. The mirror of a reflex camera needs to be of this kind in order to secure easy and accurate focusing.

Mirror and Wide-Angle Lens

We learned in a previous paragraph that the image formed by a mirror lies as far behind the latter as the image is in front. Where a large mirror is available the fact can be easily applied to obtaining photographs in places where otherwise a wide-angle lens would be necessary. The use of the mirror vir-

tually doubles the distance between the subject and the camera. Fig. 8 shows the arrangement. The subject *S* is photographed as though actually at S, the position of the camera C requiring to be chosen so that the apparatus does not come in the image formed by the mirror M. The negative so made is of course reversed as regards right and left.

Reflective Power

So far we have been concerned solely with the directive action of mirrors, but a word requires to be said on the relative reflecting powers of substances used as mirrors. No surface reflects the whole of the light falling on it. Some is absorbed; some is diffused, that is reflected, not in one definite direction but in all directions (see later, page 382). The proportion of light reflected in this latter way depends on the extent to which the surface is deficient in polish. Of the surfaces used as mirrors, that of silver (deposited on glass) is the best reflector, sending back, according to the law of regular reflection, about 96 per cent of the incident light. Polished plates of steel or copper reflect much less light though they have been used to some extent. According to a high German authority, the best metal for a mirror is an alloy consisting of two-thirds copper and one-third tin with a little arsenic. Ordinary looking-glasses with the coating on the back surface are prepared with a mixture of mercury and tin.

Transparent Reflectors

Thus far we have been considering reflecting surfaces like metal or silvered glass which are opaque. But a substance need not be opaque to be a reflector, although the reflective power of transparent bodies is very much less for the simple reason that much of the light is transmitted. But a little study of transparent reflectors will bring us in contact with a fact not hitherto encountered.

Both Surfaces Reflect

This fact is that reflection takes place from the back as well as from the front of a transparent reflector. Lay the rim of a coin against an ordinary mirror which is fairly thick glass with a reflecting coating on the back. Besides the full-strength reflected image a little way

back, you will see a much paler image touching the coin and therefore showing itself to be from the front surface of the glass. A piece of plain glass behaves in exactly the same way and is best seen—as the effect is much weaker—by holding a lighted match an inch or two from the glass and viewing the latter from one side: the two virtual images will be plainly seen one behind the other. In short, reflection takes place according to our rule of page 374 from the back surface of a transparent reflector just as from the front, except that the course of the reflected ray is further modified by the bending or refraction which it undergoes when it passes from one medium to another, in the present instance from air to glass and back again from glass to air.

Surface-Silvered Reflector

It is on this account—the reflection from each surface—that for critical purposes a mirror requires to be a single surface, that is to have the reflecting coating on the front of the glass instead of the back. The optical firms call this "surface-silvered." The mirror of a reflector camera ought to be of this kind though in some cheap makes the reflecting coating is at the back of the glass. If the latter is thin, a mirror of this kind is possible because the reflective power of the metal coating behind the glass far exceeds that of the plain glass surface and therefore the image reflected from the latter is too weak to interfere with that from the former in focusing the subject. Also the back reflecting surface is sealed between the glass and a backing varnish and does not lose its brilliancy by exposure to the air as a surface-silvered mirror does. But if the mirror is to be used for reflecting the lens-image on to a sensitive plate, a surface-silvered mirror is essential in obtaining sharpness. The mirrors used by photo-engravers for obtaining reversed negatives in the camera are therefore surface-silvered, and are sometimes protected from tarnishing by a thin coating of celluloid varnish. Surface-silvered mirrors of this sort are also used, for the same purpose, in many applications of science in every day life.

Halation Although the reflective power of a transparent surface is small—plain glass reflects only about 4 per cent of the light falling on it—it is sufficient to give rise to the unsightly defect of halation met with in making negatives on glass plates of subjects the bright parts of which come immediately against those which are darker. Patches of sky among tree branches, the windows of an interior subject, are familiar examples. The halation arises chiefly from reflection of rays, which have come through the emulsion film, by the back surface of the glass plate. This reflection causes them to return along a different path and thus to produce an extra and false effect, on parts of the film surrounding the image of the bright portion of the subject. Refraction as well as reflection plays a part here, so that I must postpone a study of it until we have dealt with the former (see page 389).

Diffused Reflection When light falls upon a matt surface like unglazed paper it is reflected, but for the most part not at all in the way in which it is reflected from a polished surface. Each bundle of rays, instead of leaving it at the same angle at which it met it, passes off as a number of rays diverging in all directions. This is called diffused reflection and is the effect produced by the great bulk of natural objects upon light which falls on them. The precise inward cause of it does not appear to be certainly known. It would seem not to be entirely due to the different angles which even a surface which is smooth to our eyes presents to waves of the minuteness of those of light: the action is supposed to be connected also with a partial penetration of the waves into the particles of the substance and their reëmergence in all directions.

Whatever may be the cause, we owe to this diffusion of light our ability to see objects from all positions, not merely from one place as in our example of the window, page 374, foot. Stupendous as the idea seems, we must imagine countless rays of light proceeding in every conceivable direction, each along a straight-line path, from every point of every object. Only by

conceiving such a condition as this can it be explained how it is possible for the eye or the lens to form an image of a scene. The whole of the light is not reflected in a diffused condition. Some, a very large proportion of the substance if it is dark, is absorbed. Some, also, according to the degree of glossiness of the surface, is reflected regularly as by a mirror. But the major proportion is scattered—up, down, sideways. You can have no better example of the action than the dark letters you see on the ground against some shop window with lettering painted in the glass. In sunlight the ground receives extra illumination by rays regularly reflected from the glass, but the painted lettering scatters the light and thus causes the form of the letters to be recorded as darker areas on the ground.

Diffusive Reflectors

In practical photography, however, we want to use surfaces which reflect light entirely in a diffusive way and therefore it is interesting to remember that ordinary white blotting-paper, such as Photo Finish World, possesses this property, rivaling in this respect freshly fallen snow. According to the most accurate measurements available, the proportion of light reflected is 82 per cent. It is probably impossible to get a better material, certainly not one which is cheaper and more easily renewed, for the purpose for which diffusive reflectors are used, viz., even illumination.

Illumination

This leads me to touch again on a point already briefly referred to in speaking of reflection from a mirror (page 378). If you look again at Fig. 7, you will realize that the action of a reflector of white blotting-paper differs from that there represented in that each direct ray is not reflected along a certain definite path, but is broken up into innumerable minor (i e., feebler) rays going in all directions. Fig. 9 illustrates this difference by showing the diffusion of light from only one narrow pencil of rays. Imagine this action to be taking place from every particle in the surface of the blotting-paper and you will understand that the illumination of the negative differs from that from a mirror in the fact that rays of light fall upon it and pass through it at

every conceivable angle, in other words, in a "scattered" condition as distinguished from one in which the rays come in much fewer directions. The result is more even illumination, particularly if the prime source of light (e. g., an electric or gas lamp) is comparatively near to the reflector. A mirror would never do in those circumstances. Moreover, for certain purposes this more or less complete scattering of the light in enlarging a negative is a good thing. We will come to that in a moment, but here we just note that the blotting-paper reflector can well be a good deal bigger than the negative in order to provide a supply of oblique rays. There is a limit to its useful size because the illumination falls off as the rays become oblique and at an angle of 30° to the reflector they are only one-half the intensity of those which proceed perpendicularly to the surface.

Diffused Transmission

As the reader knows there is another way of illuminating a negative evenly, namely, by sending light to it along a direct path, at the same time interposing a diffusing screen of ground glass or opal. In other words we diffuse the light by transmission instead of by reflection, as in the illuminating system of enlarging apparatus. The result, so far as the nature of the illumination is concerned, is pretty much the same. The passage of the light (daylight or an artificial source) through the diffusing screen has the effect, as it were, of creating a fresh source of light from which rays proceed in all directions as they do from blotting-paper. At the same time a large proportion of the light is absorbed by the screen. Rays which pass through no longer follow their original course but are broken up into feeble radiations which scatter in all directions from each point of the screen. The behavior of light in this way proves sometimes useful and at other times harmful in photographic work. Perhaps one or two examples will serve to fix the significance of this in the reader's mind.

Darkroom Illumination

Take such a simple matter as the illumination of the darkroom. Until a few years ago it was the rule to use clear ruby or orange glasses in the darkroom lamps. It was

not recognized that comfortable working is all a matter of striking a balance between the intensity of light which is without action on the plate within a reasonable time and that which produces a sufficient effect upon the eye to give the desired illumination. You get one at the expense of the other, and that applies to light of any color which the color-sensitiveness of the plate may require. One evil feature (among others) of the old clear glasses was that they allowed the concentrated rays from the light in the lamp to reach the eye, producing glare and diminishing the ability of the eye to see in the weak illumination.

The improvement came by stealth about ten years ago, for Dr. Mees, to whom our modern really safe "safelights" may be credited, found it convenient to use paper as a vehicle for some of his dyes in making them. But you will realize that with a light which distributes itself diffusively, glare is enormously reduced, and the physiological relief allows of lesser and safer illumination being used with equal comfort. It is, in fact, a maxim in the modern science of illumination in workrooms, stores, factories, etc., not to expose the eyes to undiffused light but to use a reflected or diffused light. This principle surely applies in the photographer's darkroom more than anywhere else.

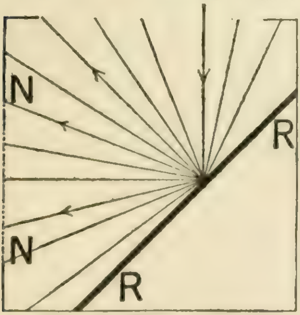

Fig. 9

The alternative to diffusion by the safelight is to put the light itself out of sight and transmit its rays by a diffusive reflector (Fig. 9). Dr. Mees did in fact embody both methods in 1907 in the darkroom lamps designed by Mr. Wratten.

Diffused Light in Enlarging

Now see another effect of this scattering of light, namely in affecting the kind of enlargement one gets from a negative. It needs no demonstration to realize that a

negative is itself a semi-transparent material which transmits light diffusively. Its diffusive action is obviously dependent on the grains of silver in the gelatine film and therefore is greatest in parts having the heaviest deposit (the high-lights of the subject) and least or *nil* in the clear (shadow) portions.

This "scatter" of light from negatives has long been recognized, but it was the Belgian experimenter, M. André Callier, who first pointed out how it is the very simple cause of an enlargement being harder in contrast than a contact print from the same negative. Fig. 10

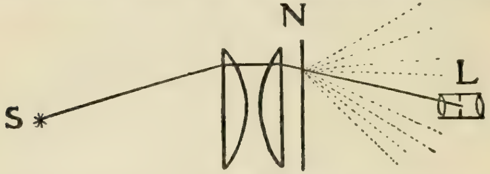

Fig. 10

is Callier's diagram showing how, in enlarging with a condenser lantern, a given ray from the light-source S, follows a definite path through a clear part of the negative N, to the lens L. But if, on the other hand, it meets a more or less heavy deposit in the negative, it is scattered, as roughly shown by the dotted lines, and hence much of the light which should be transmitted by this minute area of the negative does not reach the lens at all. Thus the shadows of the negative produce too much light-action on the bromide paper in comparison with the heavier deposits, with the result of increase of contrast.

In contact-printing, with the paper right against the film of the negative, there is no opportunity for this scatter of light rays, which therefore at every point produce an effect on the paper in accordance with the density of the negative.

In enlarging, the preventive of this hardening of gradation is to illuminate the negative by light which is completely scattered beforehand. M. Callier does this by dispensing with the condenser and placing a sheet of opal glass in contact with the negative. From

this brief description it will be understood that, apart from the quality of the paper, perfect diffusion of the light is a factor in making enlargements of contrast corresponding with that of the negative, which may account for the efficiency of the little Kodak Illuminator designed for enlarging from small negatives. It is also, no doubt, for the same reason, a reliable means of avoiding over-emphasis of retouching marks on negatives, or of the relief of carbon transparencies, when enlarging either of these.

Enlarging Boxes

In enlarging by artificial light with bought or home-made apparatus, other than condenser lanterns, the illumination is diffused, as a rule, partly by reflection, partly by transmission. The two together are so effective that it is possible to include also the direct rays from the light-source as, for example, in the illuminator for the Brownie enlarger. Remember here that the effectiveness of the light by reflection depends on the whiteness and mattness of the reflector: more on these than upon its shape. Makers of some apparatus suggest that a matt reflector of paraboloid curve sends parallel rays through the negative. It does so of course only to a very slight extent: the chief part of the light is scattered. As regards the scatter by a diffusing-screen, the nearer this latter is to the negative the better.

Light-Scatter in the Camera

Nevertheless this same scatter can act inimically. (A good word, but unfamiliar. It means hurtfully or adversely.—Ed.) A film of dust or moisture on the back surface of a lens forms a diffusive surface, causing a proportion of each ray which should proceed along its definite path to form the image to scatter in all directions. The result is that the plate receives a certain light-action uniformly over its surface, apart from the direct imagine-bearing rays, and thus yields a flat or even a veiled or fogged negative. The defect is more pronounced when the lens faces the sun more or less directly, but in any circumstances it is a common cause of lack of brilliance in negatives. It is also caused by the reflection of light upon the plate from the interior of the camera when a large lens is used.

Absorption by Diffusing-Screens It must not be supposed that the whole of the light which falls upon materials like ground-glass or opal is transmitted in a scattered direction. A little probably passes on, as though the screen were perfectly transparent, but a relatively large proportion is absorbed. Figures for the relative amount absorbed are very approximate since the surfaces and thicknesses of the materials are very various. The following are the percentages of light absorbed by the materials mentioned which are quoted for the information of illuminating engineers: Light sand-blasted glass, 12 to 20 per cent; ground-glass, 20 to 30 per cent; opal, 25 to 40 per cent. Usually perfection of scatter goes hand in hand with great absorption but there is no inherent reason why this should be so. No doubt the desirability of economical diffusion of light in interior illumination will lead to great improvements of benefit in photographic work.

Surface Absorption Before I come to an altogether different property of light-refraction, I ought to say a word on the absorption as distinguished from the reflection, which light undergoes when it falls on different surfaces. It is beyond the scope of this monograph to deal with that property of dark or black surfaces which causes the disappearance of light. It must be sufficient to say that no substance is so black as to absorb all the light which falls on it. The only black is space itself: the blackest surface you can get looks lighter than the mouth of a natural or artificial tunnel since it reflects some light. But many substances reflect very little light, which is to say that they are efficient absorbents of light. Black velvet, for example, reflects about ½ per cent, and I recollect Dr. Mees once saying that a certain black paper used by Belgian undertakers (for what purpose I have completely forgotten and am now at a loss to imagine) reflects still less. But stuffs which you can spread on any surface such as wood or metal, the so-called "dead-blacks," usually reflect more, probably 2 or 3 per cent. Surface reflection is of importance in coloring studio interiors and workrooms.

Camera Linings These facts caution us that the interior surfaces of a camera necessarily scatter onto the plate some of the light which almost every lens casts upon them, for example, the folds of the camera-bellows. If parts of wood, metal, or canvas have worn bright, the specular reflection from them may be enough to cause definite patches of fog on the plate, often to the great bewilderment of the worker. Generally the reflection will be diffused, and therefore not localized on the plate, but marring the brilliance of negatives by slight general veil.

Refraction An explanation of the refraction or bending of rays of light when they pass from one transparent substance into another is not such an easy matter. I must ask the reader to prepare himself for a little geometry, with the promise that it shall be very little. Fig. 11 is a diagram representing a ray of light AB, falling obliquely on a plate of glass, shown in section. Observations as long ago as A.D. 150 showed that it does not proceed along its straight-line path to C but at the point B, where it meets the glass, is bent into a new direction. The question is—what is the law according to which it is bent? Though it was known in the early centuries that the degree of bending varied with different substances, it was not until 1626 that a Dutch mathematician, Snellius, discovered the law. Since this law is the basis of all lens-construction, and in fact of almost every optical instrument, it is interesting to understand what it is. As an easy way to that end let us assume that by some kind of second sight we know the course the ray AB will follow, and then see how that fits in

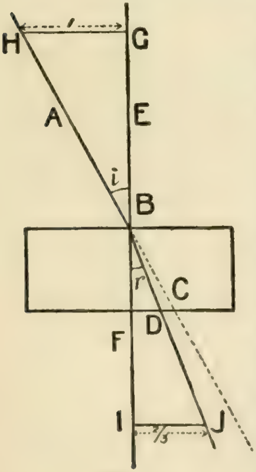

FIG. 11

with a rule. So I draw the path BD of the refracted ray in a plate of glass; also imaginary lines BE and BF through the point B and perpendicular to the glass. Just as in the reflection of light, the angle ABE is called the angle of incidence (i), DBF is the angle of refraction (r).*

Now I am going to do something which appears to have nothing to do with our problem, but wait awhile and you will see. At right angles to the perpendicular BE (continued) I will draw the line GH, meeting the original ray AB at H. Next I measure along the other side of B a distance BI equal to BG, and from I draw a line IJ at right angles to B (continued) and two-thirds the length of GH. I shall find that the end of this line, the point J, comes just on the line of the refracted ray BD. Clearly that means that my construction has led me to a point in the path of the refracted ray and now we must see how we can derive a rule from it.

Sines

In doing this, notice that the lines GH and IJ play a similar part in the construction. One faces the angle of incidence i, and the other the angle of refraction r. And you remember that we made the lines BG and BI equal, and that therefore HB and BJ are also equal. Hence it is clear that the lines GH and IJ are relative measures of the two angles which they face. They are, in fact, what mathematicians call the "sines" of the angles. Usually the sine of, say, the angle i would be the ratio of GH to HB and that of angle r HJ to BJ. But as the longer line, or hypotenuse as it is called, is of the same length in each case we can leave it out of account. We have adopted a particular construction whereby we arrive easily at the relative value of the sines without any calculation. Now we can put into words, which will convey a definite meaning to the reader, the law which Snellius discovered. It is that, for a pair of media, e. g., air and glass, the sine of the angle (i) of incidence always bears a certain relation

*Note particularly that angles of incidence, reflection, and refraction are always reckoned from the perpendicular to the surface, not from the surface itself. Thus the more oblique the ray, the greater the angle of incidence. The reader will save himself confusion if he accustoms himself to this system.—G. E. B.

to the sine of the angle (*r*) of refraction, that is to say, the former is 1½, or 1⅓, or 1¼ times the latter whatever the angle the incident ray makes with the surface.

Index of Refraction

This ratio is called the index of refraction of the material—in our case glass—in respect to the other material, e. g., air, through which the incident ray traveled. You will recollect that we drew IJ two-thirds the length of GH. Therefore the index of refraction in our example is $1 \div \frac{2}{3}$ which is the same thing as $3 \div 2 = 1\frac{1}{2} = 1.5$. If the index of refraction had been 2, we should have drawn IJ half the length of GH and so should have obtained a path of the refracted ray along a line making a smaller angle with the perpendicular than does BD. In short, we must accustom ourselves to the idea that a figure for a given index of refraction represents the size of the sine of the angle of incidence when that of the angle of refraction is 1, and when the ray is passing from the rarer to the denser medium. The other way about, if the ray is passing from the denser to the rarer medium. If you keep that clearly in mind, refraction becomes a simple matter. Note also the two rules which follow.

Refraction Facts

The index of refraction of most substances, e. g., water, glass, etc., is more than 1.

When light passes into such a substance it is bent toward the normal, as BD, Fig. 11.

When, on the other hand, light passes from such a substance into air it is bent away from the normal.

The angle of refraction in this latter case is easily drawn by remembering that the figure for the refractive index of the solid substance then represents the size of the sine of the angle of refraction when that of the angle of incidence is equal to 1.

From this it follows that when a ray of light falls obliquely on a glass plate, the two sides of which are parallel, it is bent *toward* the normal when it enters and then *away from* the normal by an equal amount when it emerges. Thus the net result of the two successive refractions is to shift the ray parallel to itself. The thicker the plate the greater the displacement of the ray.

A Rule for Drawing

Let me illustrate this point and at the same time show how an ordinary ruler and compasses permit of our exactly tracing the course of a ray through any series of refractions. Suppose a ray AB (Fig. 12) falls upon the thick glass plate at B. If it went straight on unrefracted its course would be ABC. But we know it will be bent twice to an amount depending on its angle with the surface and on the refractive index of the glass, say 1.5. First, to trace its course at the first refraction, i. e., in the glass. From center B strike two circles DE and FG whose radii are in proportion of 1.5 to 1, that is, if the outer is 1.5 inch the inner is 1 inch, or they may be 3 and 2, 4½ and 3, any radii so long as they are in this proportion. Through the point where the ray cuts the circle of *smaller* radius draw a line perpendicular to the surface of the plate. Continue this line HI to meet the outer circle in J. Then the line JB, if continued into the plate, is the path of the refracted ray, i. e., BK.

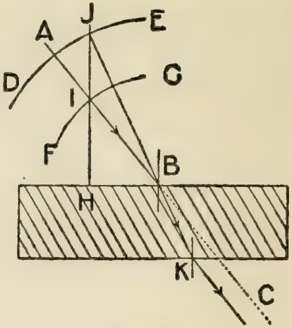

FIG. 12

The same construction (reversed) would enable us to obtain the new path of the ray BK on its emergence from the glass into the air, but the course is obtained much more simply by drawing a line from K parallel to the original ray AB, for, as we have already seen, the refractive effect of a flat plate with parallel surfaces is to shift rays parallel to themselves.

Light-Filter and Focus

Now let us use what we have learned to examine a case of practical importance, viz., the effect of a light-filter on the sharp focus of rays forming a picture on the plate. In Fig. 13, in order not to waste space, I show one only of the pair of rays passing through a diaphragm to form an image on the plate at C, where it

joins all the other rays from the same point of the subject which come through a stop of diameter double that of AB. Suppose, however, we interpose a light-filter DE, shown very thick for clearness; what happens to the ray BC and equally to every other ray coming through the diaphragm? In accordance with the method of Fig. 12 it is bent at F and G and emerges parallel to BC but shifted a little toward the edge of the filter and thus meets the central (unrefracted) ray at H instead of at C.

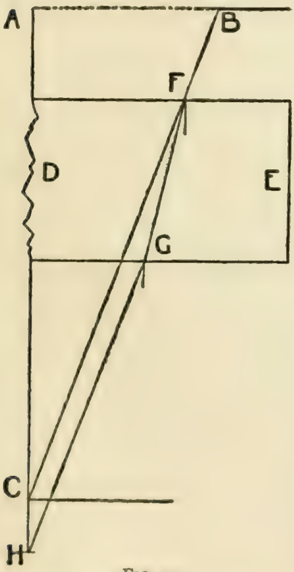

FIG. 13

Since this applies to other rays, the whole image-point or disc is at H. By drawing the refracted rays in accordance with an index of refraction of 1.5 it will be found that the backward displacement of H is exactly one-third the thickness of the filter, and this holds good for any position of the filter and for any angle of the rays. It means, of course, that if we focus without the filter and then insert it before exposing the plate, the picture will be out of focus. The degree to which it will be out of focus depends on the thickness of the plate and the angle of the cone of rays forming the image-point.

I have made this latter very large (something like $f/1$) in order to show a large shift backward: with a lens of smaller aperture the backward displacement will be the same but its effect is diminished by the narrower angle of the pencils of rays which form the image; just as in ordinary focusing of the picture, when

you are using a small stop, the picture does not quickly get out of focus with the slightest turn of the focusing-pinion. This setting back of the focus takes place even when a plate is reversed in the holder and exposed glass-side to the front, although then the displacement (one-third the thickness of the glass) is usually too slight to be of any moment. Moreover it is automatically compensated for by reversing the focusing-screen in its frame, providing that the plate and focusing-screen are the same thickness. In any event, displacement of focus due to difference of thickness will be so small as to be negligible.

Reflection and Refraction

In studying all this explanation of refraction I hope the reader has noticed an omission: he ought to have done so if he has kept in mind the previous paragraph on reflection. At any rate, look back at Fig. 11 and it will be seen at once that it does not show any reflection of the ray AB from the first surface of the glass and of the refracted ray BD from the second surface. But we have already learned that part of the light is reflected even by a transparent substance, according to our familiar law that the angle of incidence is equal to the angle of reflection. Thus, whenever light passes from one substance into another which is optically different (i. e., of different refractive power) there is always reflection as well as refraction. The two go hand in hand. So long as the light continues to travel through a medium of the same refractive index the rays of light continue to traverse the path which they took on entering the medium. The latter may actually consist of two different substances but that, if the refractive index of each is the same, makes no difference: optically they form one substance. But at the bounding surface, the two actions (reflection and refraction) come into play again. To this there is an exception which we must look at it closely.

Reflection within Surfaces

The exception concerns rays which, traveling in any substance such as glass, reach the surface which separates them from the surrounding medium—air or anything else. As we have just been reminded,

such a ray AB (Fig. 14) entering the glass plate at an angle of refraction *r*, is divided into two parts. When it meets the opposite surface at B the major part is refracted to C instead of passing straight on to D, whilst a small part is reflected to E.

Of course the action is repeated again at E as at B, but the proportion of light which in the first instance is reflected, as compared with that which is refracted, is so small that we may leave any further sub-division out of account.

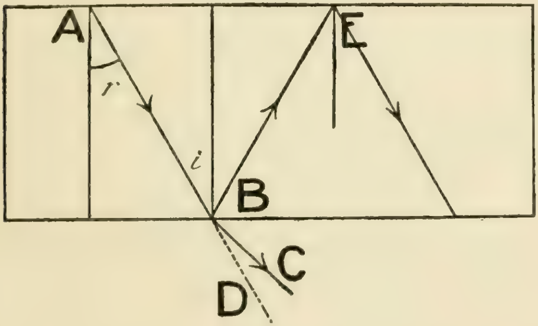

FIG. 14

But now think what will happen as the ray AB enters more and more obliquely, that is as the angle *i* becomes greater. Clearly we reach a point at which the maximum refraction is produced: the ray AB instead of following a course such as BC in the surrounding medium, is so bent that it passes along the surface of the glass. In other words its angle of refraction is 90°. It cannot be refracted more than this, and thus if the ray AB falls a little more obliquely (Fig. 15) it is no longer divided into a refracted and a reflected portion but the whole is reflected along BE. In actual experiment the light received at E is seen to jump up suddenly in intensity as this degree of obliquity of AB is reached or overstepped. The angle *i* at which refraction ceases and total reflection takes place is called the "critical" angle. For crown glass of refrac-

tive index 1.5 it is just under 42°, which means that any rays which meet the second surface of a glass plate at an angle of incidence of 42° or more are totally

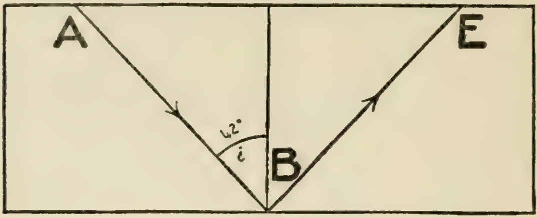

FIG. 15

reflected according to our law of equality of angles of incidence and reflection. You have the remarkable phenomenon of highly perfect reflection without any mirror surface.

Reversing Prism

This notable property of refraction from a dense into a rarer medium is used in the design of the total-reflection prism commonly fixed to the lens of a photoengraver's camera, in order to allow of the original being spread flat below it and at the same time of securing a negative which is reversed as regards right and left.

Such a prism consists of a block of glass of triangular section, one angle being 90° and the other two each 45°. Rays falling at right angles to one small face of the prism as AB and CD (Fig. 16) meet the back surface at 45° (i. e., more than the critical angle) and therefore are reflected at an angle of 45° to DE,

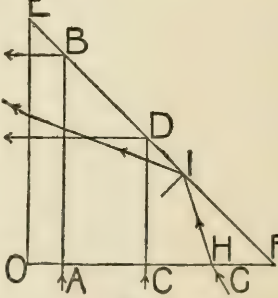

FIG. 16

that is, at right angles to their original path. Rays such as GH which strike the surface of the prism ob-

liquely are refracted equally and in opposite directions on entering and emerging and are totally reflected at the surface FE if they meet the latter at an angle equal to or more than the critical angle. But in thus using a total-reflection prism for delivering rays from an object to a lens along a path, as though the object were in front of the lens instead of vertically below, it follows that many rays reach the surface FE at less than the critical angle. Opticians therefore silver this surface and so enhance its reflecting power above that which a prism of transparent glass possesses.

It must also be pointed out that the prism requires to be of size sufficient to allow rays reaching it over a required angle of view to arrive at the surface EF with only the one alteration in their course occasioned by the refraction at the surface OF. If too small, light is refracted to the lens at the surface OE or reflected by this latter and re-reflected from EF, in either case causing ghost or glare images on the plate.

Erecting-Prism

The total-reflection prism is used in another way for the purpose of producing not a laterally reversed image in a direction at right angles but inversion of the image along the same path. This it does if placed in the position shown in Fig. 17, in which the arrows show how successive refractions and reflection bring the upper rays below and *vice versa*. This device is used in front of a projecting lantern when it is required to avoid the inversion on the screen of, say, some experimental apparatus in the lantern stage.

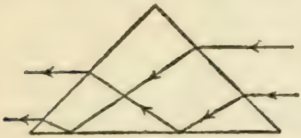

FIG. 17

Halation

Approaching the end of the study which the space of this monograph permits, we come again to halation. It appropriately rounds off the field of our inquiry, since the three things we have looked at—refraction, and regular and diffused reflection—are all concerned in the spreading of light action called halation.

Let us put the conditions under the microscope by

representing on an exaggerated scale in Fig. 18 a grain of silver bromide A in the emulsion coating on the glass plate DE. Knowing that an emulsion coating is far from opaque, and as a whole transmits light in a diffused condition, we can understand that rays reaching the particle A are scattered at all angles through the glass. Rays such as those which reach F,G,H,I, and J in the direction E are cast also in the direction D. We have occasion to consider only the former, since we know that halation is marked only when a bright part of the image comes against a dark shadow and

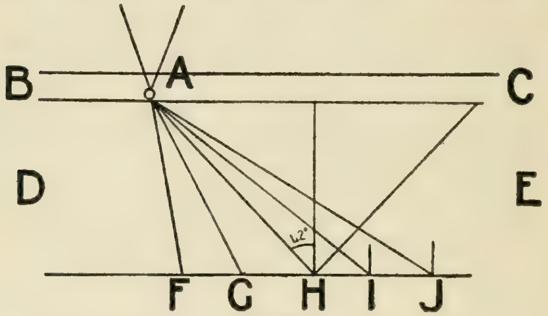

FIG. 18

we will take A as a particle on the extreme right of the bright part. The scattered rays reach the sensitive film again toward C and cause the extra action which results in the distracting light-halo in the prints.

A little consideration of the manner of their action will show how the defect is best avoided and will be a last reminder of the working of the laws we have studied. Rays such as AF and AG are in part reflected back to the film and in part refracted beyond the glass. But those which meet the glass at the incidence angle of 42° (as shown for AH) or at a still greater angle (AI and AJ) are totally reflected, 42° being the critical angle. Hence the spread of light in the film by reflection from the back surface of the glass is worse a little way from A than it is close to A—a characteristic of halation under certain conditions.

And the preventive? Clearly it may take several forms: (1) A transparent instead of a turbid emulsion; hence no scatter of rays as at A: not a practical proposition at present. (2) A light-stopping film between emulsion and glass either of slow emulsion or of some coloring film between emulsion and glass either of slow emulsion or of some coloring matter: both used commercially to some extent and very effective. (3) A coating on the back of the glass of the same refractive index but also absorbent of the chemically active rays. The third preventive is the familiar anti-halation backing for which scores of formulæ have been given. The two things just mentioned which really matter are often overlooked. The backing should be of the same refractive index in order that rays may pass uninterruptedly (without reflection) and become absorbed. If the backing allows this, it may be perfectly transparent, whilst none the less effective. A matt opaque backing cannot from its nature allow rays to penetrate: what it does not absorb at its surface it scatters back to the film. Recognition of this fact has led within the last few years to highly effective and at the same time very convenient backing of dry-plates by their manufacturers.

Conclusion

We have in reality traveled a very little way in exploring the sphere of light in photography, and have not been able to reach the more complex phenomena which play a part in color-photography or in the design of photographic lenses. Perhaps I have stepped aside too often to point out applications of the elementary laws: perhaps have been too anxious to make these latter clear even at the risk of repetition. At any rate, I hope I have encouraged the reader to look below the surface of photographic operations and to obtain a first sight of the real facts and principles upon which they rest. It should be obvious that such a conception of what one is doing necessarily adds tenfold to one's interest in photography and is bound to contribute to one's success.

GEORGE E. BROWN.

BOOKS

Few books on light are easy reading or treat the subject without a good deal of mathematics. Two which can be recommended are the following, although both are probably out of print and only obtainable second-hand.

Optics without Mathematics. By T. W. Webb, M.A. London Society for Promoting Christian Knowledge. E. & J.B. Young & Co., New York.

The Nature of Light. By Dr. Eugene Lommel. Routledge & Co., London, 1895.

Notes and Comment

In spite of the difficulties of war times, the Exhibition of the Royal Photographic Society, now open in London, is reported to be quite equal in the quality and variety of work shown to the exhibitions of past years. The exhibits are shown in three sections—pictorial, color, and scientific. This year the Society has revived the custom of giving medals, five being awarded in the pictorial section (one to Alice Choate of New York City); four in the department of color photography (all autochromes), and two in the scientific and technical section.

American photography is fairly well represented in all the sections, being especially strong in the scientific and technical department. The portraiture of the year, according to the critics, is notable for its saneness and quietness. One of the best examples of this is a home portrait by an American worker, C. Peabody, of Cambridge, Mass. As always, Alvin Langdon Coburn shows examples of his recent work, which receives high praise from the reviewers. The Hoover Art Company, of California, sends a series of six heads of young women, described as "A Galaxy of Los Angeles Youth and Beauty." Pirie MacDonald does not seem to have exhibited this year.

In the scientific section, astronomical photography is chiefly represented by work from this country and from the College of the English Jesuits at Stonyhurst. An interesting exhibit is a series of color transparencies of Saturn and Jupiter, by the Kodachrome process, sent by Prof. R. W. Wood of the Johns Hopkins University, Baltimore. The exhibits of aëro photographs from the war front, photo-micrography, radiography, natural history, and process work, are notable.

Among the printing processes used the bromide process leads, with platinum second. The oil and gum methods seem to be losing favor.

In "The Inland Printer" for September, Mr. Stephen H. Horgan, the well-known authority on process work and graphic arts, has an interesting paper upon the degenerate German in modern pictorial poster work. Germany has produced some remarkably clever and attractive poster work in the last ten years, but the particular variety foisted upon this country and still disfiguring our subway stations and public buildings well deserves the caustic handling which it receives at Mr. Horgan's hands. The paper is abundantly illustrated with examples which are to the point and convincing.

Some time ago I commended in these pages the notable achievement in hand-camera making, introduced under the name Auto-Fixt-Focus hand camera, by the Herbert & Huesgen Co., 18 East 42nd Street, New York. This camera is now in the market and may be seen at most dealer's. Representing many distinct advances in hand-camera construction, it should not be overlooked. If your dealer cannot show it to you, send to the makers for the illustrated leaflet which describes the camera very fully and illustrates its various movements.

American-made developers for plates, films, and papers, replacing the European developers, are now coming into the market in many varieties. Caltone, introduced by the Berlin Aniline Works, 213 Water Street, New York, is said to offer a perfect substitute for Metol. It has been used by some of the largest consumers in the country for the past six months and its increasing sales show that it fulfils the claims made for it. Fredol is a new developing agent similar in composition and characteristics to Metol, announced by Burke & James, Inc., of Chiçago. Using the standard formula, Fredol gives 40 ounces of developer for gaslight papers at a cost of 17½ cents, this economy and use being a special feature of this developer. Diamidophenol, said to be identical with amidol, is made by

Brewster & Robbins, of South River, N. J. It is an all-round developing agent, giving equally good results with the various papers, plates, and films on the market. Paramidophenol (Hydrochloric-Edison) comes from G. Gennert, New York and Chicago, and has the guarantee of this well-known house behind it. It may be used in place of metol in all the usual metol formulas for plates, films, and papers. There are other new developers, of which more later, but these I can vouch for as being thoroughly satisfactory and reliable.

As the result of much patient labor, we have accumulated a supply of out-of-print numbers of THE PHOTO-MINIATURE for the accommodation of readers of the magazine needing back issues to complete their sets, or who want them for their information on specific subjects. In most instances there are only two or three copies of each out-of-print number. The price is 25 cents per copy, postfree. Those who want copies should send in their orders at once as the supply on hand will quickly disappear. A complete set of THE PHOTO-MINIATURE is the most comprehensive and most satisfactory library of photographic information in the English language.

J. F. Johnston, P. O. Box 578, Rochester, N. Y., the manufacturer of Snow White Water-Color, has prepared a special demonstration card showing the uses, quality, and efficiency of Snow White as a marking fluid for titles, signatures, or decorative work in albums or on dark mounts and as a negative opaque. This demonstration card, with descriptive booklet on the use of Snow White, will be sent free to any reader of THE PHOTO-MINIATURE who will ask for it, mentioning this note. Snow White is a remarkable product and I hope that Mr. Johnston will be overwhelmed with requests for the card which shows what it will do. A generous sample of Snow White can be had, postfree, by enclosing 25 cents when you write.

The California Camera Club, San Francisco, announces the Fifth International Photographic Salon, to be held in the galleries of the Palace Hotel, San Francisco, November 25 to December 2. Prints should be mounted but not framed, and should reach the Club before November 4 next. Copies of the Prospectus can be obtained from the Secretary, 833 Market Street, San Francisco, Cal.

A Letter to the Editor: and a Few Prints which Speak for Themselves

"MY DEAR Mr. Tennant,
IT IS a year
SINCE I received
YOUR LETTER, saying
YOU WOULD like to
REPRODUCE our 1915
SALON PRINT,
AND I am ashamed
THAT ALL this time
HAS ELAPSED
WITHOUT MY sending it,
OR ANSWERING your letter:
BUT I was busy
AT THE time and
NEGLECTED IT,
LAYING THE letter aside
AND IT did not

P. T. O.

COME TO light for
A LONG time.
YOU KNOW how these
THINGS HAPPEN.
I SEND it with
OUR 1916 salon print,
AND A few others
AND HOPE they will
BE ACCEPTABLE for
REPRODUCTION in the
PHOTO-MINIATURE which
AS I have already
TOLD YOU
WE ALWAYS find
VERY INTERESTING. Yours
VERY TRULY,
MAY L. SMITH, Binghamton,
N. Y. September 29, 1916."

With apologies to K. C. B. of "The New York American"

Salon 1915
May L. Smith

"Oh wind ablowing all day long,
Oh wind that sings so loud a song."
May L. Smith


Home Portrait
May L. Smith

"If a girl has charm, she needs nothing else;
but if she has no charm, nothing else is of any use"
May L. Smith

Portrait
May L. Smith

Salon 1916
May L. Smith

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EDITED BY JOHN A. TENNANT

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Photographic Printing Processes

The outstanding fault in photographic practice today is our lack of appreciation of the print. We willingly put ourselves to endless trouble and expense in the choice of lens and shutter, in the selection of the right plate for the subject, in the arrangement of the subject itself, and in getting just this or that effect in the negative. But there our interest seems to end, and we are careless of the print, content to take what the commercial finisher or printing-room gives us without question, save that the print must be bright and snappy or soft and mushy, as the case may be. This is all wrong. The print is the thing about which we should bother: the most significant of photographic facts—the first intention and the last end of all our photography. Strange, is it not, that the professional should forget that it is the print upon which his patrons base their judgment of his abilities, on which in turn his reputation and prosperity depend! Stranger still that the amateur should overlook the fact that it is the print which sums up all his labor of love, is all that he has to show for his pains and expense! But it is true. They forget and they overlook, and one rarely sees, except at an exhibition or in the portfolios of an old-fashioned pictorialist, prints which compel our admiration as prints, while assuring us that they give us all the photographer intended us to see as his interpretation of the subject.

The Print: the Last Word

In proof of this, if you are an amateur, look over your prints in bulk, and see if they are not mere proofs, showing what you got by this or that exposure. Or, if you are a professional, look over the prints being made ready for the day's deliveries, and see whether they are not just plain and unvarnished transcripts from the negatives you happened to get of your subjects. Which, as I have already said, is all wrong. In truth, the print should carry out and sum up, as in a last word, your characterization or rendering of the subject.

Getting Back to First Principles

In this reformation of practice, this getting back to first principles, there must first be thought, the resurrection of old ideals, the cultivation of a finer perception and appreciation of the part played by the print, and then a practical knowledge of methods. The reader must know what he wants, and then how to get it. The first comes by observing and thinking, which every man must do for himself; the second, in part at least, may be gained by a careful reading of this little book and much patient experiment therein. Among the printing processes here to be discussed the reader will find abundant room for selection according to his need or taste.

Three Earlier Processes

The past ten years have witnessed a revolution in photographic printing methods. Aforetime we had albumen paper, carbon or pigment tissues, and platinotype papers. The first, almost universally used, gave glossy prints with great fineness of detail and agreeable purplish brown tones. It was slow in yielding prints, the image printing out during the long exposure required. The second gave prints of notable richness and substance, semi-matt and varied in color according to the pigment tissue employed. Its manipulation was made needlessly complicated and tedious, but the prints had an absolute permanency to which albumen prints could not lay claim. The third gave black-and-white prints, resembling drawings, on matt or rough surfaced papers, and, like carbon prints, possessing assured permanence.

Bromide Paper

Then came bromide paper, giving black-and-white prints resembling platinotypes, but much more rapid in printing than any earlier paper known, calling for exposures in seconds instead of minutes or half-hours, and cheaper in price, but lacking the assured permanence of platinotype. Because of its rapidity and its capacity for giving prints in an agreeable "sepia" color, it quickly found its place as the paper most suitable for making enlargements or large prints, for which it is today generally employed.

Print-out Papers

New varieties of print-out-papers—gelatine and collodion silver chloride emulsions—followed in the endeavor to replace albumen paper with its tedious manipulation. These quickly became popular for general contact printing and survive in the Solio, Aristo, Paget, Ilford and in the self-toning papers of today.

Development Papers

Finally came what at first were called gaslight but are now generally known as development papers, invented by Dr. Leo Baekelandt, giving prints rivaling albumen at its best but "five hundred times more rapid" according to the first announcements.

What They Are

These development papers are coated with washed chloride of silver emulsions and so are less rapid than bromide papers, but give prints with exposures of from one to ten seconds in artificial light, and are now obtainable in a hundred different varieties of surfaces, finishes, weights, etc. Normally they give black-and-white prints by development of the invisible image secured by exposure; but they may be "toned" or "redeveloped" to give brown or sepia prints or may be had in a special variety giving green prints suitable for some outdoor subjects.

Their Popularity

The use of development papers has become universal, 70 per cent of all the prints made today being on these papers. Their manipulation has been systematized to a remarkable degree; they offer remarkable facilities for the modification of the qualities of the negative in making the print and the prints are reasonably permanent.

In the choice of a printing-paper these development papers naturally call for first consideration. There are so many varieties, and these differ so widely in almost every detail, that for general use there is little need to look farther. They are everywhere obtainable in any desired size, ready for instant use, and reasonable in price. By choice among the different grades and varieties one may select a paper exactly suited to any particular negative, i. e., a paper which will give the most pleasing print possible from the negative. Or, contrariwise, one may select a paper which will enhance, modify, or suppress what is desirable or otherwise in any particular negative. To this elasticity, combined with their simplicity of manipulation and persistent advertising, the present-day popularity of development papers is undoubtedly due. It is difficult to see wherein they could be improved.

Manipulation Outlined

Briefly, the making of a development-paper print may be outlined as follows: The paper, being less rapid than bromide paper, may be handled safely in any weak artificial light, as in the shadow of one's body at 10 feet distance from gaslight or an incandescent bulb. This makes for great convenience in printing, doing away with the necessity of darkrooms or special printing-rooms. In such a light then, the paper is placed in contact with the negative in the usual printing-frame, and exposed at say, 10 inches from the light-source for from four to fifty seconds, according to the character of the artificial light used, the variety of paper, and character of the negative employed. After exposure the print (no image being visible) is immersed, face down, in almost any modern developer of the metol-hydroquinone type. The image appears in a few seconds and development is continued until the desired strength and detail are secured. The print is now quickly rinsed in clear water (or placed in a "stop" bath, usually composed of acetic acid and water, to arrest development), after which it is fixed by immersion for not less than ten minutes in an acid-hypo fixing-bath, and finally washed in running water for half an hour. The perfection of the print and its permanency depend upon

correct exposure, thorough development in fresh developer, and thorough fixing and washing.

Variations

This brief outline, of course, must be varied according to the maker's instructions accompanying each different brand or variety of paper. To summarize these variations in manipulation would require more than a hundred closely packed pages and so cannot be attempted here. The reader who would master the possibilities and use of development papers is therefore referred to the booklets and working instructions for these papers published for free distribution by the manufacturers As an instance of the fullness of the information so obtainable about any special make of development paper, I may say that any one of the Velox, Artura or Cyko booklets would occupy a whole number of THE PHOTO-MINIATURE series.

A List of Papers

The following list of these papers, compiled for the information of the reader rather than for advertisement, may be useful as showing the wide range of their variety.

Velox

Kodak Velvet Green: Smooth semi-matt; single and double weights; 50 sizes listed from 1⅝ x 2½ to 40 x 72 inches, and in rolls of 10 yards, 20 to 40 inches wide. Velox: Three degrees of contrast, Special, Regular, and Contrast. Special Velox has eight different surfaced varieties, Regular Velox, five, and Contrast Velox, two varieties. Royal Velox offers a soft tinted stock, giving prints resembling old, mellowed engravings. It is made in two grades of contrast and a medium rough surface in double-weight stock.

Artura

Artura papers, intended for professional use, are made in six brands, viz., Iris, Aegis, Chloride, Non-curling, Carbon Green, and Carbon Black. The last is advised for enlarging as well as contact printing and must be handled in orange or ruby light, being almost as rapid as bromide paper. Each of these six brands offers a variety of grades of contrast and different surfaces, single and double weights, and many sizes. Some are coated on buff-colored paper stock, the majority hav-

ing the usual white paper base. Artura Carbon Green gives the effect of a rich green carbon print very desirable for certain classes of subjects.

Azo Azo paper comes in four grades of contrast for different kinds of negatives and eleven varieties of surfaces and weights, intended for commercial work.

Cyko Cyko papers come in three brands, viz., Cyko, Professional, and Enlarging Cyko. Cyko, as made for amateur and general use, offers three grades of contrast and four surfaces in single and double weights; there is also a variety coated on Indian tinted stock, in one grade (soft) only, and double weight, for large prints or enlargements; matt surface. Professional Cyko is made in six different surfaces, and single and double weights. It is slower in rapidity than Cyko and requires wholly different manipulation, giving the warm black and sepia tones so generally needed in professional work. Enlarging Cyko is quite distinct from other Cyko brands, is intended for enlarging only, is eight times more rapid than soft (Red Label) Cyko, and forty to sixty times more rapid than Professional Cyko. It comes in six varieties of surfaces, single and double weights, and the Linen Buff and Linen White have a surface texture resembling linen with the sheen of silk. Enlarging Cyko should be opened and manipulated in orange or ruby light because of its rapidity. It is especially amenable to the hypo-alum and redeveloping processes for obtaining sepia tones.

Rexo Rexo papers are made in three brands, viz., Regular Rexo, Professional, and Enlarging Rexo. Regular Rexo offers three grades of contrast, each grade being supplied in three surfaces and in single and double weights. Professional Rexo comes in one grade only, with three different surfaces, and a special variety coated on buff-colored paper stock. It is six times slower than normal Rexo. Enlarging Rexo comes in three grades and four surfaces, including a variety on buff paper stock. It is thirty-five times more rapid than normal Rexo. There are thus forty-four varieties of Rexo paper for the different requirements of photographers.

Uro Uro papers come in three grades of contrast and five surfaces. These are inexpensive, being intended for amateur finishing and commercial work, and are obtainable in single and double weights.

Calma Calma is a special development paper intended for commercial use, being generally classed with the "black print" papers used to replace "blue prints" for illustrative purposes in manufacturing. It comes in three grades, and one surface (semi-matt) only, is extra-strong and flexible and will not readily crack or curl, nor will the prints stick together when damp. In rapidity it is similar to the Regular Rexo papers and it is offered in six commercial sizes, from 6½ x 8½ to 14 x 17 inches, being sold in packages of five-hundred sheets.

Colona Colona papers are made in three grades of contrast suited to the general classification of negatives, each grade offering three different surfaces in single and double weights. These papers are sufficiently rapid for enlarging, although primarily intended for contact printing.

Crystalla Crystalla is a development paper intended for portraiture and enlarging, one grade of rapidity only, in semi-matt single weight, matt double weight, white rough and buff rough varieties. Right-O is an inexpensive development paper made in semi-matt, single weight grade, with two grades of contrast, viz., hard and normal. It is intended for commercial use and amateur finishing.

Comment From this list it may be seen that there is a development paper suited to every possible variety of negative and use, capable of giving almost any effect desired in the print. As regards the possibilities of development papers, the reader should not be misled by the lack of quality observable in the general average of these prints as we see them in daily experience. A development print, properly made, with paper and negative carefully adjusted to each other, is equal in beauty and all the qualities appealing to the cultivated taste to the finest platinotype, carbon, or plain silver print

and, in fact, cannot always be distinguished from prints made by one or another of these methods.

Significance of Variety

The significance of the multiplicity of varieties among development papers lies in the opportunity this multiplicity offers for getting the best possible print from any given negative. To this end I can suggest no experiment in photography more interesting or more profitable than to choose a technically good, normal negative and to make a print from it on as many different varieties of development papers as are obtainable. The result of such an experiment will be a revelation of the possibilities of variation in photographic printing which the worker will never forget, and well worth all the trouble and expense involved.

Satoid Satista

Two new development papers which deserve special mention here because of the simplicity of their manipulation and the beauty of the prints they give are the Satista and Satoid papers recently introduced by Willis & Clements. Both are matt-surfaced papers giving rich lustrous prints by development, Satoid giving brown and Satista black tones. They print very rapidly by daylight, but may be printed by any artificial light if this is more convenient, requiring about one-fifth the exposure needed for the average print-out paper.

Manipulation

These papers, like platinum papers, must be kept quite dry, before use and during printing, if crisp bright prints are wanted. The exposure is complete as soon as a faint image appears showing detail in all but the highest lights. Do not examine the print in bright light. Develop for half a minute in a bath made up of ½-pound oxalate of potash, and 100 grains oxalic acid dissolved in 40 ounces of water. This developer should be used at 55° to 65° Fahr. for the best results. As soon as developed the prints are cleared by immersion for ten minutes in two baths of 1½ ounces of binoxalate of potash (salts of sorrel) dissolved in 80 ounces of water. When "cleared" wash the prints for not more than ten minutes in running water, and then fix them by immersion for fifteen minutes in hypo, 4 ounces,

water, 40 ounces, turning the prints over frequently and separating them to avoid uneven fixing and stains. After being fixed the prints should be washed for not less than forty minutes in running water. Prints made at the same time on Satoid and Satista papers should not be developed in the same solution. They may, however, be cleared and fixed together.

Carbon Printing

To the serious worker who is sure of his ability to produce technically good negatives, and who is insistent upon the maximum gradation of tones and absolute permanency in his prints, the carbon-printing process makes a special appeal. Despite its many remarkable advantages, not the least of which is that one may make carbon prints in any one of some thirty colors, it is one of the simplest and least expensive of photographic printing methods.

The Process Outlined

A carbon print is made by sensitizing carbon "tissue," obtainable from most dealers, in a solution of potassium bichromate. After being dried in non-actinic light, this now light-sensitive carbon tissue is printed under a negative by daylight in the usual way (except that the progress of printing is invisible and is gauged by the use of a tintometer or a piece of print-out paper). The print is now wetted and transferred, face down, to a piece of plain paper, or to glass, porcelain, opal, chinaware, aluminum, or any other support on which the finished print is desired, and the picture is developed by stripping away the original paper support of the "tissue" and laving hot water over the film, which dissolves away the unexposed "tissue" and reveals the picture image with all its details attached to its chosen final support. As soon as the development of the picture is completed by this laving process, the lights, halftones, and shadows of the picture all having their proper relation, the print is immersed in a solution of alum and water to harden the image-bearing film, and then suspended by wooden clips to a line to dry.

"Tissues"

The carbon "tissue" mentioned is stout paper coated with a thickish mixture of gelatine and carbon black or

other colored pigment. In buying tissue one chooses tissue of a color appropriate for the subject in hand, e. g., for portraiture, engraving black or sepia tissue; for landscapes, a soft green tissue; for seascapes, sea-green tissue; for children's pictures and some sketch portraits, Bartolozzi red tissue, and so on. About thirty different colors are obtainable in commercial tissues, and there are special tissues for different purposes and effects, e. g., special kinds for pastel and matt-surfaced prints, others for transparencies on glass or celluloid, and still others for making three-color prints by superposition.

Single and Double Transfer

As above outlined, the process, by reason of the transfer of the film, gives prints in which the right and left of the subject are reversed. If this is objectionable a second (intermediate) transfer is effected after the print has been developed and dried, which gives the subject as the eye saw it.

In practice innumerable modifications and complexities may be introduced for one purpose and advantage or another. For these the reader should consult a handbook on the process, where the various modifications are set forth in detail.

Safe-edging the Negative

The negative used in carbon printing must first be prepared with a safe edge of some opaque mixture, laid in a strip ⅛-inch wide along the edges of the negative. This is to prevent light reaching the extreme outside edges of the carbon tissue. A mask of yellow paper will serve the purpose equally well.

Sensitizing

The tissue, as bought from the dealer, is cut to any convenient size, and sensitized by immersing until thoroughly limp in a solution made up of: Ammonium bichromate, 1½ ounces; sodium carbonate, ¼ounce; water, 25 ounces. For use take 10 ounces of this and add 20 ounces methylated (Columbian) spirit. Tissue sensitized in this solution will dry within half an hour, the drying being done in a safe or non-actinic light. There are many other sensitizing formulas for different seasons and varieties of negatives.

Printing When dry the sensitized tissue is cut to the size of the negative, placed in contact in a printing-frame, and exposed to daylight until it is judged to be sufficiently printed. This knowledge is quickly acquired by an experiment or two with a tintometer or actinometer used alongside the tissue being printed.

Preparing to Develop When printed, the tissue is placed, face down, in cold water. As soon as it flattens out and lies limp a piece of plain (white or colored, smooth or rough) paper is slid into the tray under the printed tissue. The two sheets are now carefully withdrawn together in contact and laid, carbon print uppermost, on a flat sheet of glass. By gentle pressure with a rubber squeegee the two sheets, tissue and support, are now brought into absolute contact at every point and placed under moderate pressure for ten minutes.

Development The print and its support are now placed in a tray containing warm water. In a few minutes the pigment will begin to ooze out of the edges of the print, which should be uppermost in the tray. The paper backing of the tissue is now carefully eased away from the soft gelatinous mass of tissue and thrown aside. The paper support bearing the tissue is next supported on a piece of glass, inclined at a low angle within a large tray, and warm or hot water is poured or laved over the tissue until the picture image is gradually revealed by the washing away of the soluble (unexposed) tissue.

Fixing When developed the print is rinsed with cold water and immersed for ten minutes in a 5 per cent solution of alum, after which it is again rinsed in cold water and suspended by two wooden clips on a line to dry.

Variations Two-color effects are easily obtained by the use of colored papers for the support of the printed tissue; or prints made by the single transfer process above may be transferred to such colored paper bases. It is obvious, also, that a great variety of surface effects and textures are available for the finished print by proper choice among the many kinds of papers available.

Blue-Prints The simplest and cheapest of photographic printing methods is the ferro-prussiate process which gives us the familiar blue-print. Despite the fact that the blue-print has fallen into complete disrepute among photographers of late, it has many profitable uses and is worthy of a place in these pages. I have seen blue-prints used in room decoration, in making menus, place-cards and book-covers, and collections of seascapes and cloud-studies which could not have been more effective in any other medium. Of the usefulness of the blue-print for proving negatives, for the making of an illustrated negative index, and copies of plans, designs and construction or statistical records there is no need to speak.

Paper Any smooth, hard-sized paper is suitable for use in this method, such as bond and linen papers. The more porous papers, such as Japanese tissues and rice-papers, will need to be "sized" before sensitizing, and to effect this the methods and formulas given elsewhere for sizing plain papers may be employed.

Sensitizer A simple sensitizing solution is made up as follows: Prepare two solutions a few days before use. (A) 440 grains green ferric ammonium citrate dissolved in 4 ounces of water. (B) 160 grains potassium ferricyanide dissolved in 4 ounces of water. Mix these two solutions and keep the resulting mixture in a clean stoneware bottle or other container away from dust and daylight. Filter before use. Insist on the green ferric salt.

Sensitizing Sensitizing the paper should be done in weak daylight or any artificial light of not too great intensity, the sensitizer being applied to the paper as described for sizing (page 418), but with a sponge or brush or wad of cotton used exclusively for this purpose. Coat the sheet in successive strips with a brush not too dry or too fully charged with solution. Do not coat too thickly or too slowly; the brush should be passed over a 12-inch sheet as quickly as you can count ten, saying the words deliberately. After coating the sheet with strips up and down, take a slightly drier sponge or brush and pass across the

sheet from side to side, to ensure an even coating free from streakiness. After the sensitizing is completed, the paper should be dried as quickly as possible and then stored in a tin or other receptacle away from light or damp until used. Home-sensitized paper will not keep more than a day or two. The addition of half a grain potassium bichromate to each ounce of sensitized solution (or boracic acid) is said to give better keeping qualities to the paper and greater sensitiveness, and I think it does, though the gain in sensitiveness is not marked.

Negatives Clean, crisp negatives, well developed with fairly vigorous contrasts give the best blue-prints. During exposure in the printing-frame the paper gradually changes from its bluish green or orange-green to bluish gray and a dull olive-green, the shadows having a gray-bronzed, choked-up appearance. The printing should not be hurried; most beginners do not print sufficiently deep: a little over-printing can be remedied by prolonging the washing or developing.

Developing Development is effected by simply placing the print in cold water so that the whole surface of the print is wetted immediately, and changing the water occasionally until all the details are seen to stand out clearly defined and with good gradation. After changing the water two or three times, let the print remain face down for ten or fifteen minutes to thoroughly clear away the iron salts from the texture of the paper. To insure brilliant prints, development should not be done in very strong light, as this tends to veil the finer details. Water containing alkalies, such as lime, chalk, etc., also tends to degrade the brilliancy of the blue-print. This should be remedied by adding citric acid (20 grains to each pint of water) to the wash-water. A single rinse in plain water at the last will remove all traces of the acid from the print. Over-long washing, especially in slightly alkaline waters, reduces the strength and brilliancy of the print. A properly exposed and developed blue-print is always more brilliant when it is dry than it appears when in the wash-water.

Platinum Papers

Without a doubt, the most beautiful, as well as the most permanent, photographic prints are those made on platinum papers. As these papers are today either difficult to obtain or not at all gettable, it may be well to give formulas and methods with which the reader may prepare his own platinum paper at home in such quantities as he needs from time to time. The formulas and methods here advised are those published by Miss Katharine S. Stanbery in THE PHOTO-MINIATURE: No. 96, now out of print.

A big advantage in preparing one's own platinum paper is that we may use almost any paper individual taste, or the needs of the subject in hand, may dictate. Naturally the drawing or artists' papers advised for plain paper or Kallitype printing are preferable for the platinum method also. Delightful effects may be obtained by the use of Japanese vellums and tissues.

Sizing

If the paper you select absorbs moisture in any degree, then it should be sized—otherwise not, and, fortunately, most of the drawing papers and cover papers, and above all, the Japanese vellums, do not need it. Paper that is moderately absorbent will need one coat of sizing; Japanese tissues, two coats, and the thin, bibulous tissues, three. I here give the formula I use—my own proportions:

Water, 15 ounces; gelatine, 75 grains; alum, 75 grains; methylated spirits, 3¼ ounces: Dissolve these in the given order and filter the mixture.

This may be made in a larger quantity and kept a long time. I do not float my papers, as it takes too much sizing and makes them so wet that it is hard to find a good place to hang them to dry. I lay them on a large piece of paper and brush the sizing on carefully with a wide, flat brush; both sides, of course, so that they will not curl, but one at a time, so they they may be dried on the paper without being hung up. If a thin tissue is to be sized, I pin it down by all four corners to a heavier piece of paper, and finish all the coatings on one side (drying thoroughly after each one) before I turn it to the other. I never take a piece

of paper very much larger than my largest plate (8 x 10 inches).

Of course, it must be remembered, however, that while many papers need no sizing at all to take the coating, yet many of them will bear more brilliant images if sized. It would be of no advantage to size the heavy Whatman drawing papers, nor some of the hard cover papers and charcoal papers; while the heavy, smooth Japanese vellum has already such a wonderful texture that I always want it to be in evidence, free from any suspicion of sizing.

Sensitizing

As to the sensitizing. Three solutions are to be prepared, as follows: I. Hot water, 1 ounce; oxalic acid, 8 grains; ferric oxalate, 120 grains. II. Hot water, 1 ounce; oxalic acid, 8 grains; ferric oxalate, 120 grains; potassium chlorate, 2 grains. III. Water, 1 ounce; potassium chloroplatinite solution, 80 grains. [Or water, 1½ drams; potassium chloroplatinite, 15 grains. Many buy the platinum in 15-grain bottles.]

I must first discuss these chemicals. Take care that the dealer does not give you ferrous oxalate, as I have known dealers to do. Your object in the platinum process is to reduce ferric to ferrous by the action of light; if that be already done for you, you will get no picture. The label must read, either "Ferric oxalate," or "Oxalate of iron (ferric). The same care must be exercised about the platinum. It must read, either "Potassium chloroplatinite" or "Potassium chlorate and Platinum:" never "Potassium chloroplatinate." This mistake, too, has been made. The ferric oxalate comes in greenish gray scales, in brown bottles, as it is so sensitive to light; the platinum salts—in tiny red crystals, impervious to light. The plain potassium chlorate, added to number I, to make number II, is to produce contrast. Keep these in brown bottles.

I have never used distilled water—only the regular river-water. But for I and II it ought to be hot; indeed, cooking the mixture will dissolve the scales much quicker. It has been suggested to me to put in the oxalic acid (the preservative) before the scales, in order that there may be no chance of deterioration, and it is an excellent idea.

Accuracy in Weight

A very important thing to remember in the buying and using of potassium chloroplatinite is its weight: in any quantity of a dram or more you buy it by avoirdupois, and you always use it by troy. The avoirdupois ounce contains 437½ grains; the troy, 480. If you call for—say two drams of the salts, you will get a bottled labeled "one-fourth ounce," which will contain, instead of 120 grains, only 109.375 grains. So that instead of taking 1.5 ounces of water to the bottleful, without weighing it, you must take a little less than 11 drams of water theoretically: the full 11, practically, as you will generally find an even 110 grains in the bottle. At any rate, it is always best to be on the safe side by weighing all chemicals accurately, even when they are put up in the desired quantity by the apothecary. For I once knew of a drug clerk who put up some photographic chemicals in small powders for an amateur, and who, when the formula seemed to go wrong, admitted that he had been throwing in a few extra grains just to give generous measure. Moral: weigh your chemicals.

Coating

To do the coating, use a broad, flat and (especially) thin camel's hair or sable brush; camel's hair will do, but the sable is somewhat nicer and softer. Provide yourself with four chemically clean medicine droppers, with openings giving drops of uniform size. Also with a saucer, a glass of water, a large receptacle for water to wash your brush in, and your sized or unsized paper, with a piece of pasteboard or something of the sort to pin it to. Range your solutions on a table, in this order: I, II, III, water, with a marked medicine dropper for each one. Sit at the table, with the shades down, if it be daylight—all the light you want if it be night. Mix the coating in the saucer *for* each sheet as you need it. The principle or the formula is this: There are to be 24 parts of platinum to 22 parts of iron oxalate (plus some water); but the iron may be composed of any proportion of I to II—more of II giving greater contrast.

No. 1. "This should give very soft and deep black prints." I, 22 drops; III, 24 drops; water, 4 drops.

No. 2. "If greater brilliancy is required, the follow-

ing is recommended." I, 18 drops; II, 4 drops; III, 24 drops; water, 4 drops.

No. 3. "When results corresponding to silver images are required, the next solution is recommended." I, 14 drops; II, 8 drops; III, 24 drops; water, 4 drops.

No. 4. "For very weak negatives, reproductions of engraving, etc., use—" II, 22 drops; III, 24 drops; water, 4 drops.

You see it is always 22 to 24: The amount of water does not make a very great deal of difference—a little more or less. This formula, by drops, is about enough for a piece of paper measuring, roughly, 9 by 11 inches. Coat the paper first and trim it afterward; and mark the proportions of I and II that you use on the back, before coating, for future reference. You may, besides, vary the proportions of I and II just as you please. Drop the ingredients in the saucer, with the medicine droppers, and mix them by agitation; do not put in the brush until they are fairly well stirred up. (This because the brush would first absorb them unequally.) Have the brush wet to begin with, though carefully drained off. Pin the paper down by one or two corners, take a generous brushful and apply it with broad, smooth strokes, first up and down the sheet, next, transversely. Be as expeditious and work as evenly as you can, but remember that it does not require half the care that gum coating does, for there is no gum to set, and you can work over and over for a little while, putting on fresh brushfuls. Not too long, however, or the wet sensitizer will quickly deteriorate, and you will get only a faint or a patchy image in the printing. The brush should be washed after every using, and the wash water frequently changed. *This is very important.* Quickness and accuracy are essential.

Making Allowances

In measuring out the drops for a sheet of paper, allowance must be made for the grain. A very coarse-grained paper will take much more sensitizing mixture than a smooth one will. The very heavy Whatman paper, which has a diagonal grain, takes about once and a quarter as much liquid as a smoother paper, for every pore and hollow must be filled, and thoroughly. On the contrary, the

smooth Japan vellum takes less than the usual run of papers.

Allowance for the grain must also be made in printing. If rough-grained paper is exposed in the sunlight, the frames must be turned from end to end and from side to side, occasionally, or the heavy corrugations will cast strong shadows, which will not print so dark as the rest. Better still, prop the frame so that the sun's rays strike the negative at right angles, and then there will be no danger of blurring the focus.

Drying

To dry the paper, first let it hang—or lie—in the same temperature, till the surface moisture has disappeared spontaneously. Then hang it near a gas jet or a heater (away from actinic light), just hot enough to get the paper "bone dry" in from five to ten minutes from the time of coating. Not less than five nor more than ten minutes should elapse between the coating and drying operations. If it becomes dried too soon the image will probably wash away in the developer, and if not dried quickly enough the picture will be flat and sunken in. The first stage of drying must last for five minutes anyway. Store the paper in empty platinotype tubes, if you make more than you need, and use the preservative. Thus far Miss Stanbery's methods.

Printing

The arch enemy in platinum printing is dampness, which causes the paper to give flat, lifeless prints. Special care must be taken, therefore, to keep the paper bone dry before, during and after printing. This is effected by storing the sensitive paper before and after printing in tin tubes containing a small piece of calcium chloride wrapped in tissue paper, and being sure that the negative and printing frame are absolutely dry during the printing of the paper.

Sensitized platinum papers are of a lemon yellowish tint. Printing is done exactly as in the plain paper and Kallitype methods, by exposing the paper to daylight in contact with a negative in a printing frame. As platinum paper is more sensitive to light than the average print-out silver paper, the exposure required will usually be about half that needed with such papers as

Solio or other gelatine print-out papers. The image given by exposure is of a grayish-yellow tint. As soon as the shadow details of the subject are visible, the print is ready for development, so that printing is stopped when we have a semi-printed-out image, with the whole picture only faintly visible. The right depth of printing varies according to the negative, but is quickly learned by a few trials.

Development The developer for platinum papers is made up by dissolving 6 ounces of potassium oxalate in 20 ounces of hot water. Prepare this beforehand and label it "stock oxalate solution," keeping it in an orange-colored glass bottle or any ordinary bottle covered with a non-actinic paper, to shield the oxalate solution from white light. For use, dilute 2 or 3 ounces of this stock solution with its own bulk of hot water. Pour this into a porcelain or agate-ware tray and float the exposed print, face down, on the hot developing solution at a temperature of from 65° to 75° Fahr. The addition of 1 ounce of potassium phosphate to the stock solution given above will give softer and more harmonious prints where negatives strong in contrasts are in use. Almost as soon as the print touches the developer, if the exposure has been approximately correct, the picture comes up in its full strength. Usually the time of development will be from 30 seconds to 2 minutes.

Clearing and Washing The print is next immersed in a solution made by dissolving 1 ounce of hydrochloric acid in 60 ounces of water. This "clearing" or "fixing" bath is made up in bulk and a sufficient quantity poured into three agate trays before development is begun, the developed prints being passed from one clearing solution to another, after five minutes in each bath. These acid clearing baths can be used repeatedly until they are of a yellowish tinge, when they should be thrown out. The third, or last clearing bath should always be clear water-white, not tinged with yellow. After this "clearing" or "fixing" treatment, the prints need only to be washed in running water for fifteen or twenty minutes, and then dried under blotters, as usual.

Plain Silver Paper Plain silver paper is the basis of all our modern print-out silver papers. It was first introduced by Fox Talbot in 1839–40, simultaneously with his announcement of the first negative process. Its advantages are its simplicity of preparation and its economy, as well as the latitude it permits in the choice of a variety of different papers. For these reasons it has a special interest for those who want to prepare their own printing papers. It is equally well adapted for the making of small contact prints on smooth papers and large prints on rough-surface papers for the portfolio, exhibition, or for framing. It offers the widest possibilities for pictorial work as well as many professional uses, and is suited for every sort of subject except those which require a highly glazed surface paper. It is restricted, however, in the range of color or tones available, these being sepia, warm brown, purple-brown, and warm black. The first three are obtained by gold toning, the last by the use of a platinum toning solution.

Choice of Papers Any pure paper made from rags only, and free from wood pulp and chemical salts such as enter into the composition of so many of the papers of today, may be used in this method, so that one may select rough or smooth, thick or thin, white or toned papers at will. Plain silver papers give matt prints, the image being printed in rather than on the surface of the paper. If a hard-finish smooth paper is chosen, the method is well suited for small prints where excessive sharpness of detail is not essential. The image prints out during exposure. If carefully manipulated and washed, the tones are rich and vigorous and the prints, especially when toned with platinum, may be considered as reasonably permanent. The Rives, Saxe, and other so-called photographic papers, used by trade enlargers, are all readily obtainable. Any good linen paper and many of the better-class bond papers may also be used and afford ample scope for profitable experiment. Among the papers used by art students, Whatman's, Arnold's, Crane's Parchment and Glazed Bond No. 36 and No. 43, Japanese Vellum or the Mittineague

water-color papers are especially suitable for large prints by this method.

Prints with Margins In buying and cutting up plain papers for individual use, it is well to remember that in the use of such papers we may make our prints with any desired amount of margin, i. e., prints which will not need mounting but may be at once inserted in a folder or portfolio or album of any desired size. In this use of plain paper, the whole sheet is sensitized and perfectly clear white margins are obtained by completely masking the whole sheet, except the picture portion, during printing. Or one may use various sorts of border designs such as we see surrounding the subject in old portrait engravings; or the margins may be slightly tinted by the use of screen-plates of any desired depth of density; or we may place an opaque mask over the printed portion of the sheet and expose the margins only to light action until the desired depth of tint is obtained.

Sizing the Paper Whatever kind of paper be chosen, it will need "sizing" and "salting." All paper has a right and a wrong side. First mark the right or "finished" side of the paper for after guidance, as it is this side which is sized, salted, and sensitized. The sizing-base may be gelatine, agar-agar (a kind of seaweed), resin, or gum arabic, or arrowroot. A useful plain sizing is a 2 per cent solution of Nelson's No. 1 Gelatine, or a 1 per cent solution of agar-agar. Both of these sizing solutions are applied to the paper while warm, either by drawing the paper through the solution for three minutes in a porcelain or agate tray or by brushing the sizing solution well into the paper by means of a Blanchard brush. Sheets so sized are suspended by two wooden clips on a line to dry in a room or closet free from dust.

Salting the Paper Paper so sized is salted, when dry, by immersing it in a solution made up of: Ammonium chloride, 130 grains; sodium carbonate, 3 grains; water, 16 ounces; or a bath made up in these proportions. A porcelain or agate tray is used here also and the paper should be immersed for three minutes, after which the surplus

salting solution is carefully drained off and the sheets hung up to dry away from all dust as before.

Salting and Sizing Combined

To combine the "salting" and "sizing" operations, prepare the solution beforehand as follows: Rub 220 grains of powdered arrowroot into a smooth cream in 3 ounces of water, then heat 15 ounces of water to boiling-point, and into this pour the arrowroot cream very slowly with constant stirring, so that the mixture is translucent and free from lumps. Now boil the solution for three or four minutes and remove from the fire. Into 5 ounces of water put 120 grains ammonium chloride, dissolve thoroughly and add 200 grains recrystallized sodium carbonate and 60 grains citric acid crystals. Stir until all effervescence has ceased and thorough solution is obtained. This solution is now added to the arrowroot mixture and the whole filtered through two thicknesses of nainsook, while still hot, when it is ready for use. This salting and sizing solution can be applied to the paper by brushing the sheets with it (use a Blanchard brush) until the pores of the paper are thoroughly filled and the sheet has received an even, well-brushed coating, after which it is hung up to dry away from dust as before. These operations can be done in daylight.

Sensitizing Solutions

As soon as dry the paper is ready for sensitizing. Prepare the sensitizing solutions as follows: For gelatine or agar-agar sized papers, silver nitrate, 140 grains; citric acid, 100 grains; water, 2 ounces. For arrowroot-sized paper, silver nitrate, 140 grains; citric acid, 55 grains; distilled water, 2 ounces.

Sensitizing

In sensitizing plain papers we must work in gaslight or a room lighted with yellow or orange light, all white light being excluded. The sheet to be sensitized is laid, right side up, upon a flat board and fastened down at the corners with aluminum drawing-pins. A small pool of the sensitizer is now poured into the middle of the paper sheet and rapidly distributed by means of a clean Blanchard brush, so that the whole surface of the sheet is evenly and thoroughly saturated with the

sensitizer. The strokes of the brush should first be from end to end of the sheet, then across from side to side, ending with a light circular motion, to ensure an evenly coated surface. Beware of "rubbing up" the surface of the paper by too severe pressure of the brush in coating—whether sizing, salting, or sensitizing. The sensitized sheets are now suspended by clips to dry, away from all light and dust.

A Blanchard Brush

The Blanchard brush here spoken of is a simple home-made spreader or distributor. A fresh, clean brush will be needed for each operation. To make such a brush, prepare a piece of wood, say 4 x 6 inches, tapering in thickness from ¾ to ¼ of an inch, with the lower and thicker edge smoothly rounded. Have at hand, a few strips of clean, white swansdown calico or white flannel, slightly wider than the wooden support. When a brush is needed, fold two thicknesses of this flannel around the wooden support and secure it with string wrapped around the thinner end, just as the bristles of a painter's brush are wrapped.

Printing

Printing with plain papers is done just as with other papers, except that special care must be exercised to get absolute contact between the paper and the negative in the printing-frame, and the printing itself is carried a little further, i. e., deeper in tone than is usual with papers such as Solio, Aristo, etc.

Preliminary Washing

After printing, the prints are well washed in three changes of water, then placed one by one in a 10 per cent solution of common salt, then again washed in three changes of plain water, after which they are ready for toning, which is done in a porcelain or enamel tray.

Gold Tones

A simple gold-toning bath giving pleasing brown and purplish brown tones is made up as follows: Prepare a stock gold solution by adding a "tube of gold," i.e., 15 grains gold chloride to 7½ ounces of distilled water. Label this when bottled "Stock gold solution." To make the toning bath itself, put 60 grains of sodium acetate in 13 ounces of water and add 1 ounce of the

stock gold solution. If this bath works somewhat slowly at first, add 2 or 3 grains only of sodium bicarbonate. The well-washed prints are placed in this bath one at a time and kept gently moving until the desired tone is obtained, which should take at least seven to ten minutes or longer.

Fixing

As the prints reach the desired tone—examine by looking through them at the light—they are removed to the hypo fixing bath made by dissolving 2 ounces of hypo in 16 ounces of water. They should remain in this bath 15 minutes, well separated, and kept moving, after which they are well washed in ten changes of water of 5 minutes each, or placed in gently running water in a zinc or porcelain washing tank for from 20 minutes to an hour.

Platinum Tones

To obtain warm black prints on plain papers, a platinum toning bath made up as follows is employed: Water, 16 ounces; citric acid, 60 grains; potassium chloro-platinite, 2 grains. It is essential that this toning-bath shall be acid and the prints (before toning) free from all traces of silver nitrate, hence care must be given to the preliminary salt bath and thorough washing, as advised above for gold toning. After toning also, the prints must be free from all platinum and traces of acid. To effect this, the toned prints are rinsed in water and then immersed in a solution of: Salt, 2 ounces; sodium carbonate, ½ ounce; water, 20 ounces; and again well washed. Fixing is carried through as advised for gold-toned prints. When washed, after fixing, the prints may be dried between pure blotters such as Photo Finish World, under slight pressure. It should be noted that with plain papers a very wide range of variation in effects is available by individual variations in the composition of the sizing and salting solution, the toning baths, and in the use of delicately tinted papers as bases for any special effect desired.

The Kallitype Process

Closely resembling the plain silver-paper process we have Kallitype, pre-shadowed by Sir John Herschel's Chrysotype of 1841, but really a modern printing

method invented by Nicol, of Birmingham, in 1889 and perfected by later enthusiasts among whom Nelson C. Hawks, of Alameda, California, is first and foremost. Briefly, the theory of Kallitype is as follows: Paper, coated with a mixture of a ferric salt and silver nitrate, gives on exposure to light under a negative, an image in ferrous oxalate and silver oxide which, when a suitable solvent (or developer) is applied, precipitates an image in metallic silver. The prints vary in color from a rich and lustrous sepia to a warm engraving black according to the developer or toning solution employed and, with careful manipulation, are reasonably permanent.

Its Possibilities

Like the plain silver printing method Kallitype is essentially a process for those who desire to make their own printing paper at home. It has, however, greater latitude and wider possibilities in manipulation and results than plain silver paper, and may be endlessly modified to suit any and every sort of negative or to give widely varied results so far as colors, brilliancy, hardness or softness may be desired in the finished prints. By all its methods Kallitype gives beautiful prints, in this justifying its name which is made up from two Greek words signifying "beautiful picture," from which source Henry Fox Talbot derived the name of his Calotype process which he announced in 1841 = the first printing process.

N. C. Hawks' Formulas

In the following very brief résumé of the process republished from the account of its working given by Nelson C. Hawks in *Camera Craft* a few months ago, the reader is supposed to be familiar with the plain silver printing method outlined in preceding pages of this monograph. The manipulations are very similar and to repeat them in detail would be a waste of words and space.

Papers

The paper used in Kallitype printing may be any one of those mentioned as suitable for plain silver printing. Mr. Hawks suggests Weston's ledger paper 23 x 31 (70 lb.), Parson's Scotch ledger of the same weight, the Japanese papers imported by the Japan Paper Com-

pany, of New York, and the Mittineague Strathmore water-color paper.

Sizing The paper chosen is first marked on the right side and "sized" with arrowroot, gelatine, or starch as advised for plain silver printing, with the addition of 1 grain powdered alum and ½ ounce of wood alcohol to each ounce of sizing solution used. "Salting" is not advised in the Kallitype method.

Sensitizing When dry the "sized" sheets are sensitized (by gaslight or yellow light) with a sensitizer made up as follows: Distilled water, 4 ounces; ferric oxalate, 400 grains; potassium oxalate, 100 grains; silver nitrate, 100 grains. The ferric oxalate should be in shining brownish scales, yielding a clear amber solution. When thoroughly dissolved this sensitizer should be filtered through two thicknesses of fine nainsook. The sheets of paper are coated by means of a Blanchard brush as described for sensitizing plain silver paper, about 30 minims of sensitizer being needed for each sheet 12 x 18 inches. The paper is then suspended by wooden clips to dry away from white light and dust.

Printing Printing is done in sunlight preferably. As soon as the first details of the shadows are visible the print is ready for development. Longer or shorter exposure, i. e., an exposure of thirty seconds in sunlight or one of two hours in the shade, renders altogether different effects from the same negative. In damp weather care must be used to have the printing-frame, pad, and printing-paper bone dry.

The Developer The developer is made up as follows: Hot water, 18 ounces; powdered borax, 1 ounce; sodium tartrate, 1¼ ounces. Dissolve the borax first and when the solution has partially cooled add the sodium tartrate. Rochelle salts may be substituted for the tartrate if desired. To use this developer, take 4 ounces of the above and add ½ drachm of a 2 per cent solution of potassium bichromate. This developer gives a rich velvety black tone, which may be made warmer, through all the

shades of brown, by reducing the quantity of borax used. Should a purplish brown tone be desired, add a few drops of phosphoric acid to the developer.

Development Two trays are used in development. In tray No. 1 use the developer as given above with the amount of potassium bichromate advised for each 4 ounces of developer used. In tray No. 2 use the normal developer, but add only 2 or 3 drops potassium bichromate to each 4 ounces of developer. Place the exposed print in tray No. 1 for three seconds only, watching to see if the half-tones of the picture come up satisfactorily. If they do, leave the print in tray No. 1 and rock the tray gently until the picture is fully developed. If, however, the print shows too much contrast in tones, transfer it to tray No. 2 which will bring up the half-tones and details of the image. When these are properly rendered, place the print back in tray No. 1 for five minutes to clear the whites.

Fixing and Washing When the prints are fully developed, rinse them for two minutes in water and fix in a solution made up of: Water, 1 quart; "stronger ammonia," 2 drachms; for ten minutes. Henry Hall recommends the addition of 1 ounce of hypo to this fixing-bath to ensure permanency of the whites. After fixing, wash the prints as usual and dry between blotters.

Toning with Platinum To tone Kallitypes with platinum, develop as usual and then, after washing for a minute or two in running water immerse them in the following bath: Water, 36 ounces; potassium chloro-platinite, 15 grains; common salt, 150 grains; citric acid, 150 grains. Keep the prints moving in this solution until the desired tone is secured, then rinse well and fix them for ten minutes in: Water, 1 quart; "stronger ammonia," 3 drachms; after which wash as usual.

For more complete details and modifications of Kallitype the reader is referred to THE PHOTO-MINIATURE, Nos. 47, 69, and 81. These monographs are "out-of-print," but may be sought for among dealers who may have odd copies, or seen at most public libraries.

Notes and Comment

Max Weber, cubist poet and art critic, and identified in many ways with the Photo-Sesession movement, has just published a seventy-seven page brochure, entitled "Essays on Art," which is refreshingly intimate in its interest and in the treatment of its subject. The essays deal with Quality, Spiritual Tactility; Tradition and Now; Means; Things; Preparing to See; Art Consciousness, and Art Purposes.

Charles F. Rice, an expert amateur with twenty-five years of varied experience behind him (P. O. Box 517, Mamaroneck, N. Y.), sends me a dainty leaflet, headed "An Offer of Service—For a Consideration." The service Mr. Rice offers to amateurs covers the choice and selection of cameras and equipments for various purposes; the solving of particular difficulties encountered by amateurs in their use of the camera; instruction in developing and printing, enlarging, and making lantern-slides, and so on. The fee for the service is $1 per hour for those who can consult Mr. Rice in person, or $1 per letter for those who perforce must correspond. From my knowledge of Mr. Rice and his experience in photography, I can commend this service as a very profitable convenience to those who need it.

"Photograms of the Year 1916" is announced to be published in England late in December, and to be ready for delivery here late in January—submarines and other difficulties not interfering. "Photograms of the Year" occupies a unique position as the only yearbook which gives a review of the progress of pictorial

photography throughout the world, including reproductions of pictures from the London Salon and the Exhibition of the Royal Photographic Society. The price of "Photograms," as before, will be: stiff paper covers $1.25, postfree; cloth boards $1.75, postfree. As there will be only one shipment of the edition for America, and this is liable to be sold out by the time the book arrives, those who desire copies of "Photograms, 1916," should place their order with their dealer at once.

There is being held at the National Arts Club, New York City, under the auspices of the American Institute of Graphic Arts, October 4 to November 10, a retrospective exhibition of photography, showing its development, its processes, and the results achieved in pictorial photography. I hope to give a more extended notice of this remarkable exhibition in the next number of THE PHOTO-MINIATURE.

An illustrated booklet fully describing the Auto-Fixt-Focus camera is now obtainable from the manufacturers of this camera, Herbert & Huesgen Co., 18 East 42nd Street, New York. The Auto-Fixt-Focus camera is said to represent the highest achievement in American camera construction, and it certainly is a marvel of compactness, convenience and efficiency in use. The output is at present limited, but those on the lookout for a really good camera regardless of price should write for the booklet.

Down in Monroe City, Missouri, a woman photographer, Miss Belle Johnson, has for many years devoted herself to the photography of flowers, kittens and household pets, her work along these lines reaching a very high level. I am glad to see that Miss Johnson and her work are winning recognition, not only at the photographic conventions but also in the profitable world of magazine illustration.

"Practical Studio Advertising," by J. C. Abel and Chas. L. Abel, comes to my desk from Abel's Publications, Cleveland, Ohio. It is a pad containing eighty-two pages of photographic advertisements written to be suitable for the use of studios. The advertisements are bright and persuasive. They should be a help to business. The price of the book is $2.

The "Open Letter to the Photographic Fraternity," from Mr. Henry Hess, president of the Hess-Ives Corporation, which appears in this issue of The Photo-miniature, is worth looking for and reading carefully. It is the first of a series of letters in which Mr. Hess designs to tell photographers just what color photography means today, and how far Hicrography fulfils the requirements of color photography. A booklet telling all about Hicrography and the new Hiblock, which makes color photography possible with the ordinary camera, can be had on request from the Hess-Ives Corporation, 12th & Race Streets, Philadelphia, Pa.

"Wratten Light Filters," third edition revised, just issued by the Eastman Kodak Company, Rochester, N. Y., 50 cents per copy, is a seventy-one-page pamphlet, describing and illustrating the Wratten filters for the photography of colored objects. The diagrams show the absorptions of the various filters in graphic form, and tables are given with the number, name, use and remarks, stability, and approximate exposure factors of all filters. The information given by this booklet is of the definite sort much needed in photographing colored objects, and its publication puts the photographic specialist under great obligation to Dr. C. E. Kenneth Mees and the Eastman Kodak Company.

"Camera Craft" for October (San Francisco, Calif., 10 cents) is an unusually interesting number. It opens with an illustrated article by Dr. Theron W.

Kilmer on "Individuality in Portraiture," Dr. D'Arcy Power follows with a very useful paper on "Making the Best of a Reflex," and there are articles on "Photographing Projectiles," "A Wonderful Developing Formula," the usual "Photographic Digest," and similar departments.

Kodelon is a new developing agent just introduced by the Eastman Kodak Company, for use in combination with hydroquinone, for Artura, Azo, and other developing-out papers. It is said that Kodelon gives results superior to those obtained with the coal-tar developers in general use before the war caused a shortage in photographic chemicals.

Another Eastman novelty is Bromide Fabric No. 1, a fabric coated with a photographic emulsion, which works in every way like bromide paper. It is, obviously, particularly suited for commercial enlargements, prints of samples which have to receive hard usage, and large portraits intended for coloring.

The London Salon of 1916 seems to have been a remarkable success, showing that the many difficulties connected with the use of the camera in Europe at present have had little or no influence upon pictorial photography. About seven hundred prints were submitted for the Salon, of which about eighty were hung. The departments of portraiture and color photography are spoken of by our English exchanges as unusually interesting, and showing a marked advance on the work of previous years. The landscape exhibits were also notable for fine quality, and there were a few good examples of architectural photography.

Those who have the electric current at hand will find the Cooper-Hewitt Printing Outfit a marvel of convenience and efficiency during these forthcoming winter months. This equipment is illustrated in the advertising pages of this issue, but the special booklet

fully describing it can be had, on request, from the Cooper-Hewitt Electric Co., Hoboken, N. J., by mentioning this magazine when you write.

The reader who has a particularly pleasing negative, whether portrait or an outdoor subject, of which he would like an enlargement different from every other sort of enlargement within his knowledge, should send 10 cents and ask for a sample print of Artatone, a new photographic paper just introduced by the International Photo Sales Corporation, 11 East 40th Street, New York City. This is a Japan paper of remarkable quality and texture, coated with a developing-out emulsion, which gives enlarged prints surpassing in beauty anything I have seen in many moons.

A new edition of that interesting and valuable collection, "Useful Tables for the Photographer," has just been issued by the Bausch & Lomb Optical Co., Rochester, N. Y., and will be sent to all who request it, mentioning this magazine. It gives tables explaining the use of different stop systems, image heights obtained at different distances, angles of view, hyperfocal distances, shutter speeds for moving objects, etc. Send a postal card for a copy today.

Snow and Sky
Alfred Stieglitz

Frost Laden Branches: St. Beatenburg
Donald McLiesh

The Brook
Charles Vandervelde

A Winter Sunset
F. W. Johnson

Snow on the Hillside
F. Dudley Johnston

Birches
Paul Bohmen

Sunlight and Shadow
William Spanton

Winter
Leonard Misonne

The Photo-Miniature

A Magazine of Photographic Information

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Winter Photography

If this were not the topsy-turvy world it is, everybody would agree with me that winter time is preëminently camera time, and amateurs everywhere would be as busy when the snow flies and after as farmers are at harvest time. But so are we bound by tradition and ancient error that few, even of those who know and revel in the rare beauty of Winter, think of trying to capture something of her fleeting loveliness with the camera. Because, forsooth, it was ever the custom to put the camera away on a high shelf before Christmas, until summer came again, so do we almost all of us unto this day. Let us mend our ways. Think, for a moment, how generously Nature meets us more than halfway during these winter months, putting aside her summer gauds and arraying herself, now in furry browns and sunlit mists, and again as a bride in infinitely varied tones of silver-white and pearly gray, to accommodate herself to our poor plates and papers which, all summer long, have stuttered and stumbled in the face of her multi-colored glory. See, too, how graciously Winter hides so much of the ugliness of our work beneath her ermine cape, and wraps fold upon fold of filmiest chiffon and lace about our outdoor world until it seems to be a veritable fairyland.

The Gist of it

All of which is but another way of saying that we blunder sadly when we put the camera away at the end of autumn, just when, in sober truth, we should be mak-

ing ready for the most active pictorial season of the year. Wherefore we have this little book in praise of Winter as camera time.

Differences

Since, for many of us, winter photography is an unknown adventure, let us begin at the beginning and see wherein it differs from the summertime photography with which we are all familiar. Obviously, outdoor photography in winter, with snow and ice under our feet and a keen, frosty wind in the air, is altogether different from photographing the summer camp by the lake or the rippling brook in June. The big difference is, in fact, chiefly seasonal and physical, affecting ourselves rather than the photographic part of the adventure, which is really simpler and more certain of success in winter than at other seasons of the year—as we shall see.

Bodily Comfort

As in every form of winter sport out-of-doors, so in photography, the first and vital necessity is to be physically comfortable—which means principally that we must be warm and dry, suitably clad in loose, woollen clothes, giving maximum freedom of movement with absolute protection against penetrating damp and prolonged cold or chill. This applies with special force to the proper protection of feet, hands and ears. But with these details seen to, so that bodily warmth and comfort are assured, then the differences between photography in winter and in summertime are surprisingly often in favor of the former. Then, too, there is the charm of novelty. Winter scenes, with or without life and action, add a new note to the amateur's collection, giving variety and completeness to his pictorial record of the year. Nor must it be forgotten that the use of the camera out-of-doors in winter makes for health and mental stimulation, taking us out under the sky and into the sunlight when most we need what only life outdoors can give us.

Color Eliminated

Note how some familiar difficulties disappear and how in their place Winter gives new and profitable experiences. The color contrasts which at other seasons call for continuous compromise· since our plates and papers are

color-blind, are replaced by endlessly varied schemes of (roughly speaking) black and white, with intermediate tones of gray or strangely harmonious arrangements of browns and grays which the photographic process can reproduce with absolute fidelity.

Light and shade The violent contrasts of light and shadow in summertime, resulting from the intense sunlight and a world clad in leafy green, are replaced by a soft and more generally diffused illumination, altogether favorable to pleasing tone gradation in the photograph. Lacking snow, the outdoor winter scene is usually marked by softness of definition and an absence of glare, the outlines of nearby objects being softened by faint haze or mist and the masses are sober in tone. If there is snow, then we have brilliant streaks of light where the low sun slants on the white landscape, and the shadows everywhere are illuminated by light reflected upward from the snow or sky light penetrating through the open tracery of trees and shrubs.

Exposure Simplified So, too, with the difficulties of exposure—they disappear. The distractions of color and detail are largely eliminated. If we have snow, we have to avoid overexposure—a new experience! The superabundance of reflected light makes a fully timed negative the rule rather than the exception, and with such an exposure the naturally pleasing contrasts of the average winter scene are easily secured by that simplest of development methods, to wit, the use of diluted developers in a tank. If, on the other hand, it is a dull day and the snow has not yet come, then we must perforce use a tripod and give time exposures. This is a big advantage, in that it will demonstrate a fact unknown to most amateurs, that we would get more and better pictures if we would put into their making more deliberation than is possible when we expose with the camera in the hand. The use of the tripod, too, opens before us many subjects not possible with the 1-25th or even the 1-10th second exposures of hand-camera practice. The tripod here mentioned, by the way, is not the cumbersome scaffolding generally thought of, but the smallest collapsible

metal affair of its kind obtainable, as the winter camera should not be allowed to grow bigger than the 4 x 5 or 3½ x 5½ size, and more often may be that ideal size 2¼ x 3¼ now coming into general use.

Plates and Films

With the disappearance of these difficulties come many special advantages, worthy of consideration here in the beginning of our adventure because closely related to practical questions of equipment. The practical elimination of color means a great deal. For once, our subjects are perfectly attuned in this important detail to the capacities of the ordinary, everyday plate or film. There are, of course, those who insist that orthochromatic plates and color screens are essential to success in photographing the winter landscape. But the facts are against them as far as the larger part of outdoor photography in winter is concerned. To be sure, the color screen or bichromate ray filter *will* help to diminish the intense blue of the sky on a clear winter's day, and so give a truer rendering of the values of sky and snow-covered landscape or of white clouds in a blue sky. But the danger of over-correction here is as great as the evil sought to be remedied. And where we want to cut out the haze or misty distances in an open view, an ortho plate and adjusted color screen *will* cut them out, and probably rob the scene of half its beauty. So, for the most part, and save when we are working among Alpine peaks, with glaciers, crevasses and refrigerated Death in prismatic hues on every side, the ordinary plate or film (and especially the modern film) may be relied upon to give thoroughly good pictures if properly handled in exposure and development.

Films Preferred

Experience shows that there is no room for preference as between plates and films for winter work out-of-doors, as far as practical efficiency is in question. The convenience of rollfilms, their non-halation qualities and their slight color-sensitiveness, are obviously in favor of their use. If plates are used, then with such subjects as leafless trees outlined against the sky, a backed or non-halation (double-coated) plate will give more satisfactory negatives than an unbacked plate. Simi-

larly I may mention the experience of an English amateur of note, who found non-filter plates (i. e. plates having the normal emulsion coated on a substratum of yellow gelatine) useful for outdoor work late in the autumn.

The records of experienced workers in this field, in this detail of plates or films, are strangely contradictory, one swearing by backed or orthochromatic plates, another preferring the slow "process" plate because of its thick film, and others asserting that the modern rollfilm gave them negatives as fine as they ever got with plates of any kind. For winter sports and outdoor newspaper photography in cities, without a doubt the fastest plate will be needed since here speed of lens and plate are essential. But, as aforesaid, the average amateur, meeting only the usual run of outdoor scenes in his winter work, can safely use the particular brand of rollfilm he has always used and suffer no disadvantage whatever.

Cameras

In the matter of camera and lens equipment little needs to be said. Use the camera you have. The smaller and more compact it is, so much the better, the pocket camera for 2¼ x 3¼ pictures being ideal if fitted with a large direct-vision finder. This should preferably be of the simple, wire-frame sort without a lens, fitted on the lens mount so that it will fold down over out of the way when the camera is closed, and an eye-piece at the back of the camera. The pocket camera used for winter work should be carried in a breast pocket, being thus better protected from damage in an unexpected fall than if carried in the hip or side pocket of an overcoat.

Reflex Cameras and Others

This, however, does not detract one jot or tittle from the claim made for the reflex mirror camera and focal-plane shutter as best for outdoor winter work, just as it is the best camera for work at any season of the year. In fact the very bulkiness of this sort of camera, the fewness and bigness of its operating parts, knobs, levers and the like, and the recessed lens protected from flying snow dust, are all distinctly in its

favor for work when the fingers are numb with cold or encased in thick gloves. Mr. Herbert G. Ponting, whose Antarctic photographs have delighted the world, carried such a camera with him on his travels over the globe and speaks of it as preferable to all other forms. Mr. Will A. Cadby speaks glowingly of the efficiency of a 2½ x 3½ Sibyl, a small pocket model, used during his photographic trips in the Swiss Alps in winter. Mr. Donald McLiesh, an Alpine photographer of repute, prefers a camera of the rigid box type, fitted with large brilliant finders and an anastigmat in a focusing jacket recessed in the camera front.

Lenses

The lens equipment fitted to the average hand camera will meet most of the requirements of winter work out-of-doors. If its largest aperture is *f*/20 or *f*/16, of course its capacity will be limited to work done between 10 A.M. and 2 P.M. on bright days, of which every winter has aplenty. With early morning sunlight and an abundance of snow, however, a lens of this capacity will rarely fail for lack of rapidity. Thus among the experiences of men famous for their beautiful winter pictures, one constantly finds records of exposures of 1-20th, 1-30th, 1-50th and 1-100th of a second with lens apertures of from *f*/16 to *f*/22. One worker carried through a series of experiments in photographing in sunlight after a heavy fall of snow, taking an average winter landscape, making a hundred exposures in all, varying from 1-100th second to 10 seconds, with a lens aperture of *f*/11. The time chosen was a day in January, between 8 A.M. and 4 P.M. The result was that good negatives were obtained with exposures of from 1-25th to 3-5ths second (according to the hour) and an average of 1-10th second. This brings almost all outdoor winter work within the capacity of the average hand-camera lens equipment.

Speed and Focal Length

For all-round winter work, including sports and subjects with movement, a lens with an aperture of *f*/6.8 or larger is probably the most desirable equipment, giving comparative freedom as to subjects and time of day or light conditions. Where the form of the camera will

permit (meaning bellows extension), a lens of the convertible or trifocal type offers many advantages by permitting variation of focal length and choice in the size or scale of the picture image, a very desirable feature in pictorial work or in mountain photography in winter. Advanced workers in this last field often carry a modified telephoto lens for securing large images of distant subjects which are inaccessible of nearer approach. But this is a refinement concerning the advanced worker rather than the average amateur whose work does not lie so far afield.

Lens Hood

Perhaps the most important detail of the lens equipment for winter photography with snow and sunlight is a lens shade, in the form of a hood encircling the lens and shielding it from light-glare and mischievous reflections from the snow below and on all sides. This is absolutely indispensable when photographing against the sun, a method which oftentimes gives the most effective pictures of winter scenes wherein long slanting shadows coming toward the camera enhance the pictorial effects of the subject.

The First Lesson

Having thus disposed of these dry but necessary preliminaries, we can now take up the more intimate details of our adventure. To learn to see, to know what to look for, is the first lesson in all picture-making by photography. Our photographs chiefly tell, for good or evil, what we saw, which is one reason why the average amateur's collection of prints is so monotonously tame and uninteresting. He goes to the country or to the seashore and, with beauty all about him in a thousand different forms, brings home photographs of the people at the summer boarding-house or groups of bathers on the shore *ad nauseam*. So let us see, first, what the winter months offer in the way of pictorial material—what to look for and when and where to find it.

A Winter Sunrise

Some of the loveliest of winter's pictures are to be found just after sunrise, right at our doors, in town and country, or by the sea. This, by the way, does not mean rising at an outrageous hour; between 7 and 9 A.M. we will

find all we can handle. The beauty or interest of such subjects lies chiefly in the sky and the lighting effects which come as the sun makes his way up the sky.

In Town

If we live in a city, we may advantageously take our stand at a predetermined spot, so that we get a picturesque or characteristic bit of the city's skyline between the camera and the rising sun. Since we are photographing against the light, the lens hood or a sky-shade of some kind will be very helpful. Our longest permissible exposure is 1-10th of a second. The lens stop should be *f*/11 or, if the light will permit, *f*/22, all we seek being a picture of the winter morning sky with the buildings of the city silhouetted against it in half shadow. Watch the composition as the clouds form or are dispersed by the sun and make the exposure just when the sunlight rims the silhouetted buildings with light.

When the city is situated on a river of size, as New York, Philadelphia or London, then a plethora of wonderful winter sunrises may be had, with water effects in the foreground and shadowy distances, well worthy of our best efforts.

In the Country

Similarly in the country the winter sunrise offers many pictorial opportunities. Here, as before, the sky is always first in interest, a bit of woodland, or a hillside, or the roofs of houses, or the gable end of the homestead serving as a foil in the foreground to the characteristic beauty of the sky.

On the Seashore

To my mind, however, the most beautiful of winter sunrises are those seen at the seashore where the light effects on a low incoming tide spreading over the beach echo and repeat the solemn beauty of the hazy sky with the sun just breaking through. If one can secure, in such a picture, a low-lying stretch of hilly coast in the distance, the composition will be bettered. Here again we need the lens hood or sky-shade and the exposure should not exceed 1-30th second at *f*/11 or the delicate values will be ruined by over exposure, and all will be lost. In picture-making of this sort every-

thing depends upon the photographer's observation and choice of the right moment for exposure, the pattern or design caused by the lines of sky and sea playing a large part in the beauty of the picture. Beware of the noisy composition where the lines and masses of the sky conflict with the lines in the foreground of sea or beach. Where the design seems to show the gradual unfolding of the new day, with long rifts of light across the sky and a stronger slanting gleam crosses the lazy incoming reaches of the tide, we may know that we have the moment for a picture worth while. But the transformations of light and shade and form in a winter sunrise by the sea are innumerable in variety and only observation will tell which to choose and when to expose for the best effect.

Be About Early

Before we leave the winter sunrise let the reader note that the morning hours of winter days, before the sun is high, are much more favorable to picture-making than the afternoon. Not only is the light stronger, but it has a different quality, and exposures are more likely to be successful than in the late afternoon, when the light is yellowed, the air less clear and the sky fills with heavy clouds and dark masses.

Winter Sunsets

Winter sunsets have their own peculiar beauty and are well worth cultivating as picture material, both before the snow comes and after. A tripod will often be needed as the exposures will usually range from 1/5th second to 2 seconds, according to the character of the subject and the light available. In woodland scenes, especially where the darks predominate and before the snow falls, I have often given exposures of 5 seconds when working against the low setting sun at *f*/11. A narrow roadway or curving avenue, with bare trees at either side, and the low setting sun lighting the far horizon makes a pleasing subject of this sort. Similarly, a tree-bordered brook at the base of a sloping meadow, with farm buildings or a cottage silhouetted against the fading sunlight in the receding distance, is another good subject in the same class.

Before the Snow Comes It is a grievous mistake to await the coming of the snow before thinking of winter photography. The changing season, as the golden browns of October fade into the austere grays of December, offers wonderful possibilities for the camera along the countryside or in the city parks. Delightful perspectives, the charm of atmosphere and the play of imagination awakened by familiar things half hidden, half revealed in mist and haze, all belong to this time. Wherever we have a combination of leafless trees against the sky and a pool or stream, or the edge of a lake to give a gleam of light or echo of the sky, there, early in the day or as the sun declines, we will find the most desirable material for picture-making.

The Charm of Leafless Trees There is an indescribable grace and loveliness for those who appreciate beauty in form in the leafless branches of trees or the bare twigs of a bush photographed against the light. The solid, impenetrable masses of foliage and the deep dark shadows have vanished, and in their place we have an infinite variety of delicately outlined branch forms, reminding one at every turn of the exquisite stencils of Japanese designers seen at art exhibitions. For these stencil-like designs provided by the dainty tracery of tree branches, it suffices to point the camera at the sky, taking care that the design desired comes within the picture space, and give the briefest exposure. A gray sky is more favorable to success than a clear blue, and the exposure should not exceed 1-25th second or the delicate outlines of branch and twig will be lost in the halation or spreading of the light. A reflecting mirror camera is peculiarly useful for this kind of work, because of the facility it gives for viewing the picture image up to the moment of exposure.

Exposure Generally, in this before-the-snow picture-making, where the brown earth and somber tree masses are included, generous exposures are required to get sufficient detail and a proper separation of the planes, so that a tripod must be used. This season offers many favorable opportunities for deliberate picture-making, with all the natural elements in our favor.

In Town The season of leafless trees, before the snow comes, also offers special opportunities to the town dweller, in that many buildings and public monuments well worthy of pictorial record can be photographed to the best advantage when screened or partly screened by the decorative forms of trees without leaves. I recall a picture of this sort where a row of city houses, in themselves as plain or as ugly as might be imagined, was made quite interesting and pleasing to the eye by the skillful use of such a screen of softly defined leafless trees. Park fountains and similar public monuments presenting large dark masses in graceful outline against the light are often helped materially in a pictorial sense if we can view them against a screen of trees.

River Fronts in Mist It is at this season, too, that the pictorialist revels in the morning mist or haze along the river fronts or harbors of coast-wise cities. In such a setting the ugliness of port warehouses and modern bridges, huge cranes and the city looming up in the near distance, is subtly veiled in suggestive forms which excite rather than depress the imagination. The play of sunlight will often add immeasurably to the strange beauty of such subjects if skillfully handled to give emphasis where needed to relieve the general grayness of the scene. Pictures of this sort being chiefly schemed in tones of gray with occasional patches of white are enhanced by printing in platinotype. I have seen such studies of the lower Thames, of the Frith of Forth and of our own East River with the Brooklyn Bridge, handled in this way and they were a delight to the eye.

When the Snow Comes But it is only when the heavy frosts and snow come that the loveliness of winter is seen at its best, and there are pictures everywhere. The heart leaps at the thought of it, this ever new and ever unspeakably wonderful miracle of the snow which, in a few short hours, transforms the look of the world, hiding its ugliness and depressing detail and softening the hardness of its too insistent outlines, so that it looks like a brand new and different world altogether.

Remember These Things Coming down to prosaic fact concerning the photographing of winter scenes after a fall of snow, there are three things ever to be remembered by those who seek success in this picture-making.

Beauty is Fleeting The first of these things is that the beauty of the snow lies chiefly in its pristine freshness, and that this beauty is as fleeting as the love that lies in woman's eyes. In the country, remote from cities, the snow retains its whiteness and virginal purity for days; but in the city its beauty vanishes within a few hours. There is, too, an exquisite texture in freshly fallen snow, which catches every gleam of light and gives a charm to the photograph wherein it is shown, but it quickly disappears. So the wise photographer will seek his snow pictures as quickly as the snow begins to fall, before it loses its first fresh loveliness and texture.

Snow is not White The second of these three things is that snow is not white—photographically, in the sense that it can be reproduced truthfully by spaces of white paper in the print. Even snow in sunlight, which is the brightest white we know, has an exquisitely fine, textured surface, made up of countless tiny hillocks tipped with light and equally tiny hollows filled with the shadow of the hillocks aforesaid. So that if we would get the illusion of snow into our snow pictures, we must retain these delicate gradations of light and shade by careful focusing and correct exposure and development.

Look to the Illumination Which brings us to the last of these three things to be remembered, to wit, that the most important technical detail in all picture-making where snow is concerned is the illumination or lighting of the subject. Rarely, if ever, can the beauty of snow be reproduced if the snow is lighted directly from above. Always see to it that the light slants across the surface of the snow at a fairly low angle. By this device the light "picks up" every tiny hillock of the surface, and the shadows of surface irregularities, footprints and tracks in the snow, upstanding rocks, shrubs and trees are elongated, and the

print will have a charm which no mere representation of snow by bare white paper can give. This means photographing before 10 or 11 in the morning, or possibly after 3 in the afternoon if the day is exceptionally bright and clear or the light will permit.

Three little things to be sure, but of more real importance than pages devoted to exposure minutiæ. Your appreciation of their significance will have an astounding influence upon the pictorial quality of your winter's work with the camera.

Concerning Definition

A point concerning definition must come in here. The faulty representation of snow by bare white paper, seen in so many winter pictures, is often due to a dirty lens, covered with a thin film of fine dust particles or a veil of moisture. It also results from poor focusing or a slight blur caused by lack of steadiness in holding the camera during exposure, or from overdevelopment which blocks up the tiny points of brightest light. The mention of these things suggests their remedy. The use of the lens hood is a further help toward brilliancy in the picture image.

It is, of course, impossible to reconcile all this with the use of "pictorial" lenses and the methods adopted by some pictorialists by which poster effects and winter studies or arrangements in two or three tones are made. These may, and often do, suggest the beauty of the snow-clad world in interesting ways, but they are personal and individual impressions or interpretations for the most part, and hardly come within the scope of our adventure here.

Let me now give place to notes from the records of others who have done good work in winter photography, taking only such experiences as are likely to help the many rather than the few.

Trees and Foregrounds

"When working with trees on a snow-covered slope," says W. B. Post, "do not have the light directly on them. For myself, I prefer to work against the light shading the lens with my hat or, better still, with dark brown paper rolled in the shape of a megaphone and placed over the lens. Care should be taken that the rays of the sun,

while they should not shine directly into the lens, should fully illuminate the ground glass or picture space. Often I use a tree trunk, standing in such a position as to shield the lens from the sun, while the subject itself is well lighted.

"One of the most difficult problems in snow landscape work is the foreground. It is, of course, not desirable to have a pure white expanse like a winding-sheet; and if foreground studies are sought for and the subject at hand does not arrange itself to satisfy your ideas of composition, this blank expanse can be acceptably filled by a trodden path (somewhat overdone nowadays), or oblique tree-shadows, which are preferable. In this case it becomes almost necessary to have your source of light from the front or front sides of your lens. By doing this the sun will shine through (if such a term will apply), instead of on, the snow; the direction of the shadows will be more pleasing; the sparkle and quality of the snow will be much truer, and your distance will be softer—in fact, all the planes will be more in harmony, and that disagreeable wiryness so often seen in snow-landscapes will disappear. There may, of course, be times when the light from behind is to be desired, but in foreground work it can seldom be done without introducing shadows from the sides or rear, which do not explain themselves. When your subjects are the delicate tracing of frostwork or the honeycombed surface of March crusts, the forward lighting is almost a necessity. This latter work in the early spring, before the sun gets too high, is most fascinating, and, at that time, the results of freshets and breaking up of the river give subjects that are grand, even if one can do no more than look at them when they are too crowded, which is often the case. Much more to my taste is a snow-scene with fewer and smaller objects instead of large masses.

"Springtime in its early stage furnishes many opportunities—melted snow and water, swollen streams, and even the first rains when the snow is on the ground and the air is full of moisture and atmosphere. In this last condition, and with only a minimum of sunlight, you can get some very unusual and beautiful results, par-

ticularly if some snow-covered roofs or trees are in the middle distance of the scene."

Winter Landscapes Writing of serious pictorial work afield, Phil. M. Riley tells us: "A never-ending variety of picture-material presents itself constantly in winter, especially in the country, where beautiful motives are to be seen in almost every direction. Thus it is that the matter of selection is one worthy of careful thought. Harmony of composition as well as simplicity of arrangement should be constantly striven for, the common fault being to include too much within the picture-space. A snow foreground cut athwart by the shadows of trees; snow-covered walls and fence-corners; paths through the leafless woods or sighing fir trees; city streets and country roads; the sloping banks of streams, open or ice-bound; snow-laden bushes, and subjects of a similar nature lend themselves readily to the camera.

"A study of the best pictures by painters and photographers of high standing will furnish admirable suggestions regarding what to photograph. In such pictures observe above all things how simple are the landscapes and how homely is the human interest where figures are included—the paucity of material in either instance. Their successful appeal is not due to the exalting grandeur of natural scenery on the one hand or the winning beauty of personal perfection on the other, but rather to the fact that one dominant theme has been rendered simply and with the fewest possible number of accessories. Stories are best told in few words; pictures, likewise, depend upon simplicity for their strength. The message of a picture loses its power of appeal in direct proportion to the number of objects required to express it, so let them be few, all harmonizing with each other as well as with the idea to be conveyed. To successfully compose a picture within the four boundaries of the print means to exclude everything which is unessential without omitting anything which is indispensable.

"The successful application of these principles will tend to emphasize the sentiment of winter in a picture, if such a sentiment be present. It is, after all, upon this

quality that a picture stands or falls, and to attain it should be the ambition of every worker. It is an indefinite thing to explain, since it depends partly upon the subject, partly upon the composition and partly upon the technique; but when present in a picture of fair size one always feels, when looking at it, an instinctive impression of coldness in the snow and frostiness in the wind, causing a momentary shiver and desire to button one's coat more closely.

"Life, whether man or beast, when brought into a landscape always places it on a higher plane and aids in creating sentiment and feeling. As the figures usually become of supreme importance in the composition, they must be placed in strong positions, and the general principles of composition are quite as applicable in snow-photography as elsewhere. Everything should be subordinate to the principal object, which should be emphasized by lines, by masses of light and shade, and by spacing and placing.

"Very often shadows themselves are of sufficient interest to supply practically the entire motive of a picture. In fact, snow-photography more than any other branch of camera work lends itself to simplicity of composition; with snow upon the ground very little is needed to make a picture, and the views gain in strength thereby. One dominant idea directly expressed with the fewest possible number of accessories always makes the most beautiful and forceful picture. Then, too, because of the meager amount of material included, each item can be given more careful treatment, with the result that there is better opportunity to secure the true feeling or sentiment of winter. This means realistic snow-texture and a definite, readily understood atmospheric condition and direction of light, which, as you look at the photograph, will make you feel something of the coldness, windiness, wetness, or other characteristic of winter. Full gradation, transparent shadows and sparkling, detailed high lights when the sun shines are some of the qualities which will aid in securing this feeling. Skies, too, are important, and any view is best photographed when the sky is in harmony. Newly fallen dry snow is best rendered

when the sun shines, and there are light clouds; the atmosphere should be bright and clear. Wet snow and slush call for misty atmosphere and soft, dull skies. Wind-swept snow permits of bold rolling clouds suggesting motion."

Sunny or Cloudy Days

William S. Davis, a firm believer in isochromatic plates, backed with gummed black paper, a four-times color screen and an exposure meter as essential to good work out-of-doors in winter, says:

"Whether it is best to work on a cloudy day or in bright sunshine depends wholly upon the character of the subject and the effect one wishes to produce. Generally speaking, a cloudy or diffused light not only shortens the scale of contrast, but divides the subject into a few flat masses of light and shadow, which may increase the decorative quality of an open landscape. On the other hand, when it is desirable to catch all the delicate undulations on the surface of the snow, which produce such subtile nuances of tone, or to make the most of lines and details formed by broken paths or snow-laden twigs and bushes, sunshine will prove a valuable aid. Often the beautiful shadows cast by an old fence, or a network of tree branches overhead, form such charming patterns upon the snow as to transform what would otherwise have been an uninteresting composition into a very attractive picture.

Values

"In dealing with snow-scenes, one should try to cultivate a keen eye for "values"—*i.e.*, the relative intensity between the light and dark tones throughout the subject—so much depends upon their proper translation. For example, don't start out with the idea that snow is absolutely white; for under ordinary conditions only a small portion seen in any subject could be truthfully represented by pure white paper in a print. Those elusive shadows and tinges of color which indicate the surface texture, and also help to give aërial perspective, must be retained. What is needed is to treat these tonal gradations so delicately that the feeling of *general brightness* in the snow shall not be lost.

"It may be stated, as a general rule, that an expanse

of snow under the open sky will be lighter in tone than the sky, whether the latter is cloudy or a clear blue, unless one is facing the direction of the sun. In this case the two may be of virtually the same value. Still such a lighting is not often desirable if much of the sky is visible in the composition, because a very bright sky in a picture destroys the luminous quality of the snow. In cloudy weather, shadows on the snow are usually lighter in tone than the sky; but in strong sunlight the reverse is the case.

"What has been said about retaining the tonal values of the snow applies equally to the darker passages such as tree trunks in shadow, which cannot be represented by absolute black without destroying all sense of aërial perspective—the feeling of light and air enveloping all objects.

"Often the best compositions are derived from small bits of foreground, particularly such subjects as snow-laden bushes which are effective only at close range.

A Few Rules

"From the foregoing, the reader may rightly infer that success in taking snow or ice scenes depends, from a technical standpoint, upon the preservation of tonal gradations throughout the entire scale, and this is best accomplished by observing the following rules:

"Use backed or double-coated non-halation plates (preferably color-sensitive) to take care of the delicate details in the higher lights.

"Expose long enough to obtain detail in the deeper shadows without forcing development.

"When snow (particularly if upon tree branches) comes against a background of blue sky, or the surface is covered with very delicate blue shadows, place a ray-filter on the lens.

"Develop for the snow, and, if the exposure is sufficient, the detail in the deep shadows will come out at the same time."

Few workers in photography have shown a more thorough understanding or a surer mastery of picture-making in winter than the Cadbys. The following notes are from papers by Will A. Cadby and are as inspiring as they are helpful.

Figure Studies

"What an admirable background snow makes for figure-studies! These alone might keep an enthusiast busy all winter. Think of the delightful rendering the camera will give of figures on snow—all the tiresome detail of the background obliterated. This is one of the strong features of snow-portraiture, and it is curious it is so seldom used. If we wish to break up the white sheet of paper which a plain snow-field will give, we can swing the camera round until we include in the view a pictorial bit of fence which will just suggest distance. Indeed, the background can be controlled to almost any extent to suit the portrait we are making. The results are camera sketches, and very often *character* sketches, thanks to the simplification of the surroundings produced by the snow, which in turn gives emphasis to the salient points of the figure.

Decorative Studies

"A snowy landscape offers grand opportunities for what we might describe as decorative treatment. The delicate tracery of a branch, every twig of which is outlined with snow, is a subject which is full of possibilities. A bit of forest, too, heavily draped in fresh snow, where the light and shade are almost bewildering in their subtlety and infinite gradation, will yield many decorative effects—effects which will tax the technical skill of the photographer to its utmost.

Technical Points

"And now how to go about taking snow-photographs: To begin with, we must aim at the technically perfect negative. We have not the same latitude here as with ordinary subjects; for, with the latter, if the exposure has not been hopelessly wrong, a print which is passable can be produced. Now a passable print of a snow-subject will not do; it will not represent snow. Ever so little over-exposure will probably result in flat fogginess; and chalk and soot will be the effect of the opposite fault, when all the delicate highlights will be buried in the depths of the negative, never to appear on a print. So we must ensure correct exposure, working systematically with an actinometer, making the calculations very carefully. If this is done, the rest is comparatively

easy. A thinnish, brilliant negative is the sort to aim at, unless, of course, it is intended to print in carbon, when it must be built up more steeply in development. Personally, I rely on dilute Rodinal for all my snow-negatives, using, as a rule, one part Rodinal to forty parts water, but it must not be forgotten that Rodinal works much slower at a low temperature, and as snow-photography is essentially a cold-weather job, the water with which the developer is diluted should be warmed to about 62° Fahrenheit."

Hoar-frost Effects

The curious beauty of hoar-frost effects offers an attractive field for camera work in winter, and should not be overlooked. It is a field especially rich in decorative natural forms which, apart from their own interest, have a ready market among designers, illustrators and periodical publishers seeking material for pictorial cover and title-page designs.

Those who live in the suburbs or in homes with gardens have abundant opportunities for this sort of work. The city dweller will usually have to seek his material early in the morning in the nearest park or city garden.

The most favorable time for securing these effects is between 8 A.M. and 10 A.M., before the morning sun has reached the subject. Avoid trying to include too much of the subject in the picture space. The secret of success lies in keeping the fairy-like structure of the tiny, glittering frost crystals without mutilation. A dark background is desirable as showing the lovely effects to best advantage. As the exposures should be full, rarely less than ½ or 1 second with the lens stopped to *f*/22, a tripod will be needed. Wind-movement during exposure needs attention, and the focusing of the image should be done with extra care to secure perfect definition. Side lighting is usually advised as emphasizing relief.

Street Scenes

City streets in winter after a snowfall do not present any unusual difficulties, the chief points needing attention being the choice of the best viewpoint for the effect desired in the picture, and the most favorable moment for the

exposure where traffic is likely to interfere. The details of the foreground will need constant watching.

Perhaps the best time of the day for this work is during the late forenoon, by which time the heavy yellow haze of the city's winter morning has practically disappeared. A certain amount of this haze or mist, however, is desirable as serving to veil the ugliness of the average modern street or square and helping, also, to accentuate the note of wintry weather. Sometimes the most interesting effect can be had during an actual snow storm.

The most rapid plates or films available are required for work of this sort because of the movement included in the scene. A gleam of sunlight will add brilliancy if available. With a lens working at *f*/6.8 exposures will range from 1-25th to 1-10th second. For a late afternoon exposure with a blinding snow falling, the best plan is to set the camera up on its tripod within a sheltering doorway, or to work from a convenient window, and give an exposure of 2 minutes with the lens at *f*/8. See that neither snow nor moisture are allowed to veil the lens or under-exposed and blurred picture images will result.

Winter Nights

Night-photography in winter, when the snow lies thick and heavy in city streets or about the country home, is a fascinating field of work for those who are not easily discouraged by discomfort and have a fair stock of patience. It is tripod work of course, and calls for the fastest lenses and plates to make the exposures less tedious.

The Country Home

In the country a night when the moon is full should be chosen and the windows of the country home should be lighted as in use. Under such conditions and with a lens working at *f*/4.5 or *f*/6.8, an exposure of 10 minutes will usually give a negative yielding all the characteristic effects of the scene. A country church, with its windows lighted for service and the pathway to the lighted doorway fairly well illuminated, will generally yield a desirable negative with half an hour's exposure at *f*/11. Such an exposure will include a printable image of the snow-laden trees in the street or about the church building.

City Streets In city streets one's subjects will be more or less confined to buildings unusually well lighted, such as the entrance to a theatre or library, a house where an entertainment is in progress and so on. The snow in such cases is well trodden down and more or less slushy, if not cleared away. An exposure of 2 or 3 minutes with a lens at *f*/4.5 or *f*/6.8 will, according to the volume of light available, give a reasonably good negative.

Parks Sometimes a city park, well lighted by electric arcs on unusually tall standards (and so generally out of the picture space) will afford material for successful night work in winter. Here the clean or piled up snow will be helpful and charming designs given by crossed shadows on the walks and snow may be obtained. Exposures here should be at least 15 minutes with a rapid lens and plate. Backed or double-coated plates are advised.

Outdoor Sports Of photographing winter sports little needs to be said since it does not differ materially from the photographing of summer sports, except that there are more failures, due to the lack of light despite the snow reflections and all that. Where there is a great abundance of snow on every side, and we can photograph our subjects against a field of white snow, as in skiing, tobogganing and so on, this difficulty is more easily overcome. But usually it is a case of using the fastest of plates and lenses fitted with focal-plane shutters and doing one's best. One of the most difficult of all photographic subjects within my knowledge is the flying iceboat, and most of the ice-yachting pictures I have seen were made before the start or after. This suggests, perhaps, the most satisfactory method of getting pictures of outdoor sports in winter. Take the camera, by all means, regardless of light and weather conditions, and seize the opportunities when the players are resting, or the occasional moments when the movement in the scene is comparatively slow. In the course of a winter, by making the most of such opportunities, one can add quite a few delightful and interesting pictures of sports out-of-doors to one's collection.

Photographs with Rapid Movement For almost every form of outdoor sports in winter, the reflecting-mirror camera and its focal-plane shutter offer manifest advantages. For example: in photographing skiing, tobogganing and ice-yachting scenes, the usual method followed is to take a favorable position from which a view of the flying figures or boats may be secured, coming toward the camera at an angle of 45 degrees. The camera is pointed at the spot where the subject will pass and carefully focused; this done, the movement of the subject is watched and as it reaches the pre-determined spot (this being observed on the focusing mirror of the camera) the shutter is released and the exposure made. The full-size focusing finder and the focal-plane shutter with its speeds of 1-500th to 1-1200th of a second are here the prime factors of success. It is presumed, of course, that such work will be done at the middle of the day when the light is at its best, and that the most rapid plate and lens will be used.

An Exposure Table The following table, calculated by Phil M. Riley for work of this kind, is based on the use of a 6-inch lens working at *f*/6.8, with the subject about 25 feet distant from the camera.

Subject	Right angles to camera	Approaching at 45 degrees	Coming directly toward camera
Tobogganing, Ice-boating, Ski-jumping	1-1200	1-800	1-400
Skating, Hockey, Coasting	1-900	1-600	1-300
Sleighing	1-240	1-160	1-80
Snowshoeing, Skiing	1-120	1-80	1-40

What it Tells "This table tells just about what can be done with any particular shutter. It shows that with the ordinary shutter one must watch for opportune moments of slow motion in sports involving more rapid movement than sleighing, but that with a shutter working up to 1-300th, of which there are several costing only a few dollars extra, the field of skating and hockey can be entered, and even

the highest class of tobogganing and ski-jumping at a distance of 50 feet. With moving objects at the latter distance, exposures for all these sports need be only half as fast as stated for 25 feet and at 100 feet or more still longer exposures will arrest the motion.

"Correct exposure for the plate or film, insuring reasonable detail in dark objects and shadows, must be thought of as well as enough speed to arrest motion and avoid blur. In winter the sun is lower and the light less intense than in summer, but the reflection from white snow is much greater than from green foliage. Correctly timed negatives result from exposures of about 1-50th second at *f*:8 for three hours at the middle of the day, but rapid motion requires greater shutter speeds. The remedy, of course, lies in a rapid plate or film possessing great latitude and permitting a little forcing in development, and in an anastigmat lens of large working aperture. Plates of double the average rapidity cost only a little more and make correct timing with exposures of 1-100th second possible, while with a lens working at *f*/4.5 the same is true of exposures of 1-400th. Thus equipped, the more speedy exposures, even in the most strenuous of winter sports, rarely involve less than half correct timing, so that careful handling in tank development will yield almost perfect negatives.

Development

"Thirty-minute tank developments with glycin or eikonogen, both clear working developers, will make the most of these exposures tending toward under-timing, and are well suited to all winter sport work. The slow action of the weak solution gives a chance for shadow detail to develop to the full before the high lights have become too dense. Glycin is probably the best of all developers in extreme cases of under-exposure. It does not discolor readily nor stain or fog the plate even after long immersion in it. The following formula, made up in the order stated, is intended especially for high-speed work: Hot water, 25 ounces; sodium carbonate (dry), 1 ounce; glycin, ¼ ounce; sodium sulphite (dry), ¼ ounce.

"For use take two ounces of the stock solution to

thirty ounces of water. Correct exposures will reach complete development in thirty minutes at a temperature of 60 degrees. In extreme cases of under-exposure development may continue several hours with benefit, even over night. Freedom from fog, sufficient printing density, reasonable detail in both snow and shadows and dark objects are the qualities to look for in the negative. To avoid staining the negative, rinse off the developer thoroughly with clean water before immersion in the acid fixing-bath."

Scenes with Less Rapid Movement

The reader who does not possess the equipment here mentioned as practically essential to success in photographing winter sports may, however, secure many pleasing pictures with a lens working at $f/6.8$, or even at $f/8$, and an exposure shutter with speeds up to 1-300th of a second. This, as I have said, means avoiding unfavorable light conditions and choosing scenes including slow movement such as skating, sleighing, etc., or in watching for the moments of rest in the movement of the subject in hand. In most instances it will mean either a slight blurring or lack of definition in the picture image, or an under-timed negative. The latter is the wiser choice since it can be remedied to some extent by patient development in the tank with a much diluted, clear working developer such as citol, glycin or eikonogen.

Finis

Here our adventure ends. Much more might have been said and neglected winter opportunities pointed out, which must perforce be left unmentioned for lack of space. But I hope that the adventure, such as it is, has done something to open the eyes of the average amateur to the fact that wintertime is camera time, and has awakened the good resolution that this winter the camera shall not be put aside and forgotten as in winters past.

Notes and Comment

The Exhibition of Photography, held under the auspices of the American Institute of Graphic Arts at the National Arts Club, New York, October 4 to November 10 was noteworthy in many ways.

The intention of its projectors was to present a retrospective view of the development of photography from its discovery in 1839 down to our own day. As a consequence the exhibits were largely historical in character and possessed an unusual degree of interest. In this detail the American Institute of Graphic Arts were fortunate in securing early examples of photographic work from the remarkable collection of Prof. Charles F. Chandler, of Columbia University, and other collectors who sent specimens of the daguerreotype, ambrotype, and other processes of long-past days. There were also a few original prints made by Julia Margaret Cameron, David O. Hill, H. P. Robinson, and a small but exceedingly interesting collection of photographs of the Civil War and President Lincoln, by Brady and others of that time. The Eastman Kodak Company sent a special exhibit illustrating the progress of photography since the first introduction of rollfilm in 1883 down to their latest introduction of Kodachrome transparencies in color of 1915.

The section devoted to photography as an illustrative art attracted much attention from visitors. It included a complete set of modern books illustrated by Alvin Langdon Coburn in photogravure and photographic prints; an educational collection showing the methods employed in old and new reproduction processes, contributed by the F. A. Ringler Co., of New York; and a few good examples of photographic poster work. In this section, also, I noticed with satisfaction a fairly complete display of American photographic

periodicals and books, a welcome recognition of the generally ill-requited labors of our American photographic editors and publishers past and present.

The chief interest of the exhibition, however, centered in the pictorial photographs, a well-chosen display of about two hundred and fifty prints representative of almost a hundred amateurs and professionals in photography. Among these the first word of praise must be given to the achievements of the women workers, which were marked by their delicacy and refinement of imagination, combined with an unusual degree of interpretative power, and amply sustained an old notion of mine, often expressed in these pages, to wit, that women and photography are preëminently adapted to each other in nature and temperament. I cannot find room here for mention of all the prints by women workers worthy of individual praise, but a word must be said for a portrait of a child by Francesca Bostwick, a simple, unaffected bit of work exemplifying the best traditions in this difficult field and wholly satisfying. Mention must also be made of the clever work sent by Gertrude Kasebier, Alice Boughton, Jeanne E. Bennett, Alice Choate, Rose Clark, Mrs. Walter L. Hervey, Marion Meisel and Clara E. Sipprell.

Alvin Langdon Coburn was represented by eight of his best prints, including his remarkable interpretative rendering of St. Paul's, London—a print which grows on one year after year. Dr. A. D. Chaffee, Richard M. Coit, William B. Dyer, Edward R. Dickson, Baron De Meyer, Arnold Genthe, Elias Goldensky, William M. Hollinger, Clarence H. White, Karl Struss, Pirie Macdonald and W. H. Porterfield sent prints which well sustained their reputation as masters in photography. The wonderful dance pictures by Arnold Genthe were among the prints most generally admired and two tone studies by Edward Henry Weston were generally surrounded by a crowd of enthusiasts seeking inspiration.

A special section was devoted to color photography, almost all the modern methods of reproducing color being represented in the collection. The best examples were a few transparencies sent by Henrietta Hudson

of New York, including a marvelously clever color reproduction of a soap-bubble. Praise must also be given to the examples of the Kodachrome method sent by Dr. Nathan T. Beers, and a demonstration of the Hess-Ives Hichrome method, showing its simplicity of manipulation and effective results. Otherwise the color section was disappointing and not adequate as a display of the best work accomplished in this branch of photography.

The exhibition was very largely attended and gave evident pleasure to its thousands of visitors. The American Institute of Graphic Arts deserves the grateful praise of all interested in photography for its inception and carrying out of so interesting a display of the possibilities of camera work.

The second of the series of letters on color photography by Mr. Henry Hess, appearing among the announcements in this issue, deals with the Hiblock, a word of mystery in which very wonderful possibilities are wrapped. The Hiblock enables one to get a three-color record with a single exposure—but why not see the letter itself?

G. Gennert, New York, Chicago, Los Angeles, San Francisco, advises me that he has just received a large consignment of Imperial flashlight plates. These are intended for winter work or wherever extremely short exposures are necessary or desired. They have a fine-grained emulsion despite their great rapidity, and are much favored by press photographers and those who have to deal with children during the winter months, as well as for general flashlight work.

The daintiest bit of advertising I have seen this year is the quaint Japanese booklet about Artatone for prints and enlargements, sent out by the International Photo Sales Corporation, 9 East 40th Street, New York. The beauty of an Artatone enlargement must

be seen to be appreciated, but a sample print on Artatone, with the booklet, can be had by sending 10 cents in stamps to the manufacturers addressed as above.

The Sussex Photo Supply Co., Newton, N. J., advise us that they have just introduced a new variety of Colona development paper with a soft emulsion, intended for portrait work. Samples of this new paper can be had by photographers who will write upon their letterhead.

Turning over some old numbers of "The Scientific American Supplement" the other day, I found in the number dated January 14, 1911, an account of "Jarman's System of Electric Traction by Storage Batteries," in which I learned to my surprise that Mr. A. J. Jarman, who wrote the monograph published in THE PHOTO-MINIATURE No. 142, "Profitable Processes," was a pioneer inventor of the electric tramcar, or as we call it, "street-car." The system invented by Mr. Jarman involved the construction of a double-decked street-car which was successfully propelled by electric storage batteries. Some $75,000 were spent in experiments covering eight years, but apparently the system was perfected and electric storage cars were actually in use in London as far back as 1886.

Possibly the present system using electric power for our street-cars is so far perfected that it will never be replaced by the storage-battery system, but this latter has doubtless great usefulness today in the automobile industry. I am glad to make a record here of Mr. Jarman's achievement of so many years ago.

Readers are reminded that the new volume of "Photograms of the Year 1916," reproducing selected examples of the best photographic work of the year here and abroad, will be ready for delivery late in January next. This information also applies to "The

Penrose Pictorial Annual or Process Yearbook 1917," which will be ready about the same time. As the American edition of both these annuals is generally taken up and completely sold when the books arrive, it would be well to place an early order with your dealer in order to avoid disappointment.

Those who lack "out-of-print" numbers of THE PHOTO-MINIATURE Series for the completion of their sets of the magazine or other purposes are here advised that the publishers of THE PHOTO-MINIATURE have gathered together a fairly large collection embracing many, but not all, of these out-of-print numbers. While they last, these numbers will be sold at the regular price of 25 cents per copy. Those desiring them should state their wants without delay, as in many instances only two or three copies of the different numbers are available.

"The American Annual of Photography," 1917 (Volume 31); edited by Percy Y. Howe, published by The American Annual of Photography, Inc. For sale by Tennant & Ward, New York. Prices (advanced), paper covers $1, postage 10 cents; library edition, $1.50, postage 15 cents.

There is no falling off in interest, either in the text or the illustrations, of this well-known and popular yearbook of photography. The editor tells us that his space has not permitted the inclusion of all the contributions, pictorial and literary, which were sent him for the Annual. This has evidently permitted a selection of the best of the contributions received, which possibly accounts for the high average value of the contents of the volume. The illustrations range over almost all the uses of photography for pleasure and profit and are beautifully reproduced and printed. The articles are, as usual, from workers of prominence in various special lines at home and abroad, and deal with a wide variety of topics. The book forms a valuable addition to photographic literature of the day and should find a

place on every photographer's bookshelf. It can be had from most dealers.

The C. P. Goerz American Optical Company, New York, has just announced a general increase in the salaries of its office and factory staff, to take effect December 15, 1916. The proposed increase will add more than 10 per cent to the present pay-roll of the company.

The reason given is the ever-increasing cost of living, which the company feels should be compensated for as far as is possible under the somewhat adverse conditions which the Goerz Company has to work, on account of the European war. In spite of these difficulties, however, the Goerz Company has thus far managed to supply all orders for its famous anastigmats, cameras and other photographic accessories.

Some time ago I published a paragraph in these pages calling attention to the profitable possibilities of the use of dolls, small lay figures and the little toy animals usually found about the home, for the making of photographs of unusual interest. At that time I pointed out that some amateurs had marketed such pictures with considerable profit to themselves. In a recent publisher's announcement I note that Will and Carine Cadby, of London, have together produced "The Doll's Day," a charming gift book for children, illustrated with twenty-nine photographs of dolls doing things told of in the tale. It is a story of three dolls that come alive for just one day and have a series of exciting adventures. Just the book to buy for the girl "kiddies" this Christmas.

The Fourth Annual Pittsburgh Salon of Photography is announced by the Photographic Section of the Academy of Science and Art, to be held at the Galleries of the Carnegie Institute, Pittsburgh, Pa., from March 1 to 31, 1917. The aim of this Salon is to exhibit only

that class of work in pictorial photography in which there is distinct evidence of personal artistic feeling and execution. All work submitted to the Committee of Selection will be carefully and impartially considered and no preference will be given to the work of members of the Salon. All pictorial workers are cordially invited to contribute. No pictures are eligible that have been exhibited heretofore in the United States. For particulars and entry forms address the Secretary, Photographic Section, Academy of Science and Art, Pittsburgh, Pa.

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Copying Methods

Ever since photography began the copying, or reproduction by means of the camera, of photographs, designs, prints, sketches, paintings and the like, it has been a profitable specialty of the professional studio. Today, on New York's most fashionable thoroughfare, you may see photographers' show-cases displaying a choice collection of photographic copies of Daguerreotypes and other old prints or paintings, with the legend: "We make copies of your old and treasured prints—as good or better than the originals." And one well-known photographer has for many years past gathered an annual revenue running into four figures from his skill in this specialty. The amateur, too, has constant calls from his family or friends for copies of this or that treasured or rare portrait or print, and I need only mention the many instances of photographers whose sole specialty is the reproduction of paintings and works of art for collectors, museums and publication. Despite which, we have no handbook in English for those who work in this wide and profitable field, in which the camera is supreme in usefulness and efficiency, except THE PHOTO-MINIATURE, No. 41, long out of print and difficult to obtain now-a-days. To fill this gap, I have persuaded Mr. George E. Brown to write the monograph which follows. It embodies practically all that the average worker, be he professional or amateur, will need to make him successful in this special field, unless he specializes in the reproduc-

tion of colored originals, such as paintings, in which case he will still need Dr. C. E. Kenneth Mees's "Photography of Colored Objects," recently published in a new and revised edition.—EDITOR.

"Copy" and Copy

At the outset I should define one shop term which the reader will meet here and elsewhere. By some strange perversion, the original line-sketch, engraving, painting, or what not—which is to be copied, is called "copy." Thus copyists speak and write of good "copy" and bad "copy," meaning, not the results, but originals which are easy or difficult to reproduce. Similarly, the support for the original is often termed the copy-board. Recollection of this technical use of the word will perhaps save the beginner some confusion in his reading of articles on the subject in technical journals.

Size and Scale

The necessary distinction should also be drawn between these two terms. The former is ambiguous. Without further qualification it does not tell us if, for example, a half-size copy is half the area or half the breadth of the original. "Scale," on the other hand, is definitely understood to refer to one dimension only of the original. A 4 x 5 copy of an 8 x 10 original is half-scale although, as regards area, it is one quarter the size. But since "size" is sometimes used in reference to length or breadth only, the term "scale," on account of its perfectly definite meaning, will solely be used in these pages. I will however admit the much-used phrase "same-size," since it can have only one signification.

Apparatus

The outfit for copying may be as simple or as elaborate as one pleases; it is chiefly a matter of convenience and speed. The possessor of a dollar camera need not think that our special branch of work is beyond him, though he will require more ingenuity and patience than the owner of a "Photostat," the instrument specially designed for making copies by the score in the minimum of time, and costing little short of $1,000. I must limit myself to telling the amateur how to use his own camera and how to fit up apparatus solely for copying at small expense. It should be said at once that, if

much work is intended, a few dollars spent in providing a camera equipment specially adapted for the purpose will be repaid to one a dozen times over in the certainty and quickness with which the work can be done and in the wider range of one's capabilities.

Plate or Film Camera

It should be said, in the beginning, that copying is a branch of work in which the all-convenient film camera is at a double disadvantage. In the first place, in the case of most patterns, it does not allow of the use of a focusing screen upon which the picture can be adjusted as regards size and sharpness; and, in the second place, it is limited to the employment of roll-film as the sensitive material. This latter is a real handicap, since roll-film is obtainable coated only with emulsion of very considerable speed and of one quality of color-sensitiveness, whereas in copying there is a great call, according to the "copy" for the variety of emulsions available on glass plates. These objections do not apply to film cameras adapted, as some models are, also for the use of plates in holders and fitted, in addition, with a detachable focusing screen. View cameras fitted for plates, with focusing screen and long bellows extension are, on the other hand, well adapted for copying. Such view cameras, and the older types of cameras with square (not conical) bellows, may often be picked up second-hand at a small expense. Beyond these, we have the commercial copying and enlarging cameras properly designed and intended for such work.

Extension

The feature in which the folding hand-camera is deficient is in its lack of extension (distance from lens to plate). This deficiency arises from the fact that the cheaper models of either focusing or fixed-focus cameras are made for photographing things not nearer to the camera than, say, seven to ten feet, and the maximum extension of the camera requires to be little more—and usually is not much more—than the focal length of the lens, say four to six inches. But if we require to copy something same size—a very usual requirement in copying—then the distance from lens to plate must be at least twice the focal length of the lens, say eight to

twelve inches. If you cannot get that extra four or six inches, you cannot get your copy; or, alternatively, you need to get along without by shortening the focal length of your lens. In other words, there are two courses open to you: (1) Provide an extension tube or box, either at the front for the lens or at the rear for the plate-holder and focusing screen; or (2) fit a supplementary glass to the lens which will reduce its focal length to about half. These latter are generally listed in the catalogues as "portrait" or "copying" attachments and may be had from most dealers.

Extension Tubes

The first plan is the less easy because more often than not the lens is a fixture or, even if it can be removed, its panel or front is very awkward for the attachment of an extension tube or box. Moreover, the lens-fronts of these small cameras are themselves small, and therefore the extension tube has also to be of comparatively small diameter, with the result that, after you have got your extension fixed up you find that it cuts off the spreading beam of rays from the lens and leaves the margins of the plate unexposed. With some cameras it may be quite satisfactory to fit an extension tube of sufficient length and diameter, but try it out first temporarily with a stiff paper tube before getting a permanent extension in brass, or making one of strawboard, wetted so as to bend without breaking and then glued to form an open-ended cylinder.

An extension-box to slide or fit into the camera back and made to carry the plate-holder at *its* rear is a practicable though rather clumsy expedient. Also it needs to be well made, or it is worse then useless. I know I should never succeed in making one; which perhaps is why I recommend the reader not to waste time over this method, but to avail himself of the optical and much neater system of shortening the focus.

Extra Lens for Copying

At the cost of about a dollar you can get a lens for attachment to that on your camera. It is really nothing more than a single achromatic lens of just about the same focus as the lens fitted to the camera. While a plain spectacle glass of the requisite focal length and costing a few

cents will answer the purpose, it is better to get a proper "copying attachment" as supplied by most dealers, for the reasons that its optical quality is better and it is fitted with spring clips, by which it is fixed securely to the camera lens in an instant. With the copying attachment in position, you will find it necessary to use a fairly small stop in the lens, in order to secure sharp definition over the whole plate. As a matter of fact, the attachment entirely upsets all the stop numbers marked on your lens; but there is no need to worry about this. Simply find out how far it is necessary to stop down in order to get sharp focus over the plate, as you can best do by focusing on a page of printed matter. Make a note of the stop number required and use it in future. You don't require to know what stop number it actually is, because, as we shall see directly, the exposure depends on the extension of the camera so long as the same stop-aperture is kept in the lens.

Copying Camera Proper

But, as I have said, it will amply pay the copyist to fit up a camera specially for his work, particularly as it needs to be of quite a primitive pattern in comparison with the present up-to-date models. If you are doing that, the chief things to bear in mind are: (1) The camera should preferably be of the old square-bellows type (the front as large as the back); (2) all the better, if a size or two larger than the plate you are going to use: (3) should have a rear-focusing movement—it doesn't matter if it is the only one; and (4) should have ample bellows extension, say two and one-half or three times the focal length of the lens. This degree of extension will allow of copying not only same-size but on a somewhat enlarged scale. All the other movements, rising and swinging front, swing back, etc., are almost useless in a copying camera which is better without them. A camera which by modern standards is a hopeless back number is the best for our special purpose (providing it is well made), and can often be picked up from a dealer in second hand apparatus for a few dollars. An old 8 x 10 portrait camera has served my every need for years.

The "Why" of a Copying Camera

Why is the foregoing specification the best? Well, the large front allows us to fix any lens we prefer or may happen to have. The large size and the square bellows both avoid veiling of the negative from light reflected on to the sensitive plate from the bellows. Focusing from the rear (that is, moving the plate instead of the lens) is better because, with it, you are doing only one thing, viz., sharpening the image, whereas, when you focus by moving the lens you are also altering distance from lens to original and therefore altering the size of the image on the plate. In making a series of copies on different scales, this latter is a very real hindrance to speed of work. Last, in a copying camera, the proper place for the lens is opposite the center of the plate and dead "square" with it, and so there is no need to have the many movements the object of which is to provide the maximum departure from this condition.

Lenses

The call for a lens of high quality is a matter of one's requirements. The authorities will tell you that a single or landscape lens, such as is fitted to cheap hand-cameras, is useless for copying on account of its distortion. It bows out straight lines near the margins. But you can copy scores of originals such as portraits, old prints, and the like, without a sign of such distortion which one can detect. Morover, the use of the copying attachment tends to offset this bowing property of the single lens. In short, there is no need to abandon the idea of copying ordinary subjects for want of a high-grade lens, although for the accurate copying of originals composed mainly of straight lines, drawings, plans, architectural subjects, etc., a double lens, e. g. a rapid rectilinear, anastigmat or portrait lens, is necessary.

The R. R. Lens

Considered all around, a rapid rectilinear lens is the best for copying. Many photo-engravers prefer a lens of this type to any other, probably because a R. R. works at its best at an aperture of about *f*/16, and most copying is done with the lens stopped down to about this degree. Therefore, if you are fitting up a camera specially for

copying, you cannot do better than equip it with a rapid rectilinear, choosing a focal length about half as long again as the long side of the plate. For example, six inches for a 3¼ x 4¼ plate: seven and one-half inches for 4 x 5, and ten and one-half inches for 5 x 7. In accordance with what I have just said about camera extension, these focal lengths should go, respectively, with cameras affording about 18, 23 and 32 inches distance from lens to plate. This combination will allow of copying on a two-times scale of enlargement, or more still by fitting the lens with a copying attachment.

Anastigmat and Portrait Lens

But let not the reader think that a lens of the anastigmat or portrait type which he may happen to have is unsuitable. On the contrary, a high-grade anastigmat is excellent for the purpose. My point is that, when buying a lens specially, it is not necessary to incur more than the small expense involved in the purchase of an R. R., new or second-hand. And I would insist here, as I shall do again, on the fact that copying ceases to be a nuisance and becomes a pleasure in proportion as one has the right tools set apart ready for use on the odd occasions when, as a rule, one requires to do it. But as regards anastigmats, if you have one of focal length a little longer than the long side of the plate, by all means use it, getting an extra flange for fixing to the front of the copying camera. The great covering power of an anastigmat permits of this somewhat shorter focal length being used, but there is of course no objection to lenses of the focal lengths just specified for R. R.'s being employed. The case of a portrait lens is somewhat different. Its covering power is very much smaller, insomuch that the focus requires to be pretty nearly double the long side of the plate. That means a bulky and heavy lens for a given size of plate: in most cases too bulky, unless one has a camera of exceptional size. At the same time, the definition given by a portrait lens over its narrower field is very fine, equaling and often exceeding that of the best anastigmat. But, unlike the anastigmat, its field is not flat. You can't use as much of it as you can in portraiture. Practically, the adoption of a portrait

lens will be determined by the possession of a big copying camera.

Much Enlarged Copies

It may be worth mentioning here that, where the lens or the camera does not allow of copying upon the enlarged scale desired, a copy negative of the size permitted by the apparatus can be made, and "prints" made from this by enlarging in the ordinary way. This is not a good method for line originals (for reasons which will appear later); but for full-tone subjects, if care is taken to get proper sharpness in the negative, there is no reason why the results may not be quite as good as those made direct on the enlarged scale.

A Lens Hood

Whatever lens is used, it is never a disadvantage, but very often a very positive gain, to fit a hood to it for the purpose of cutting off all light except that reflected from the copy board. The object of this is to avoid stray light in the interior of the camera, with its effect of veiling what should be perfectly clear parts of the negative. It is the most efficient way of doing this, and, when it comes to copying line subjects such as pen and ink or pencil drawings, a distinct aid toward getting the best result. The hood can be of the simplest form—an open-fronted square box, say four or five inches in length and an inch or so wider than the lens mount, to which latter it is fixed by a round hole in what may be called the back of the box. The inside of the hood should be painted dead-black, and this remark applies equally to all wood and metal parts inside the camera. In copying, the effect of light reflected on to the plate, which would pass unnoticed in ordinary view or portrait work, is liable to give rise to markings on the negative simply because the light, even character of originals like sketches or drawings, makes such easily discernible in the copy negative.

A Copying Stand

Perhaps the most important item in an outfit for copying is some form of stand on which the original is supported and along which the camera is moved. Even if the reader uses only his hand-camera in his copying work, he should make, as he easily can, some kind of stand,

for he will find it facilitates operations enormously. The plain purpose of it is to provide a convenient support for the original and to insure that, however the camera be moved, the lens points squarely at the original: in other words, that the latter is always parallel with the plate. A stand of this kind may be of various forms, the making of none of which is beyond the powers of anyone who can use a saw and plane.

A Simple Stand

As simple a pattern of stand as any, and one which I made and have used for twenty years past, without finding the need to discard it, consists of two long flat boards, each about eight inches wide and about one inch in thickness. These are screwed to three cross-bars underneath, so as to leave a space or channel between them about half an inch in width. No need for any skilled carpentry here: it is only necessary that the inside edge of each board should be planed true throughout its length so that the channel is of uniform width throughout. This forms the baseboard of the stand. To carry the camera, first get a flat board (call it *A*) best of some hard wood, and measuring, say twelve inches in width, sixteen inches in length and one inch in thickness. To the upper side of this board is screwed a box (*B*) of width and length to carry the camera and of height to bring the lens opposite the center of the copy-board or easel, next to be fixed to the base.

If the camera is quite a small one, the dimensions just given may be halved, in which case it is just as well to make the support of the camera a block instead of a box, for the reason that plenty of weight is an advantage as regards stability of the camera during exposure. Moreover the camera is then not liable to be accidentally shifted once the original has been placed and focused; a heavy support causes the camera to stay where it is put. To the under side of the board and running straight down the middle of it is screwed a fillet of wood the width (or a shade less) of the channel space in the baseboard and about half an inch in thickness. This guides the camera squarely as it is moved back and forth. With the attachment of the camera to the box or block B, this part of the apparatus is com-

plete. Some cameras can be fixed by a short screw passed through the hole ordinarily used for attachment to a tripod top and engaging with a "bush" let into the top of the box or block; but others, such as turn-table view instruments and many patterns of hand-camera, are not amenable to this method of fixing. For them, the best plan is to nail a fillet of wood along one side of the top of the box (or block) and to attach a couple of screw fitments to the other side by which to press the camera base-board firmly against the fillet on the opposite side. A suitable screw-fitting costing a few cents can be picked out from most stores selling hardware specialties. Whether the attachment is temporary or permanent—the latter is an easy matter—care must be taken that the camera back, i. e., the plate, comes squarely across the copying baseboard, and is therefore parallel with the easel, which is the last item in the way of apparatus.

The Copy Board

Just exactly what form this part of the outfit should take depends on the provision one wants to make for various descriptions of original. If there are likely to be only drawings, etc., which can be pinned up, nothing more and nothing better is needed than a plain flat board to which soft linoleum has been glued. A very suitable description of material passes by the name of "cork linoleum." The board should be, say 20 x 24 inches—few will require it larger—and is attached by a couple of stout right-angle brackets to a base measuring, say 16 x 8 x 1 inch, and fitted on its under side with a guide fillet in the manner of the board, A, for the support of the camera, already described. It can thus be moved back and forth parallel with the plate, a movement which is sometimes convenient, as it saves stretching over the rear of the stand in cases when the camera has to be pushed up fairly close to the easel.

A Pressure Frame

On the other hand, if there are objections to defacing originals even to the slight extent of pressing push-pins through them, then the board requires to be of rather more elaborate construction. It needs to be a glazed frame, hinged to a base-piece so that it can be brought

up into the horizontal position, the original laid centrally in it, a spring back put in, and the whole then brought up square with the lens. A well-made printing-frame, fitted to a base with stout hinges and provided with a spring strut or stops to bring it automatically into an upright position serves the same purpose, but is less speedy in use than the frame described.

Copying from Books

And then, again, there are many copyists, the bulk of whose work for lecture purposes will be done from books—which are awkward things to handle without some special provision. One very simple device for holding

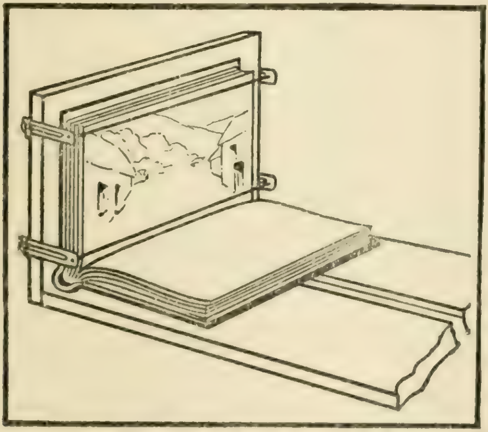

FIG. 1. Copy-board for holding books.

an opened book flat is shown in the drawing, which almost explains itself. (Fig. 1.) The rods are best of brass—iron rusts and is liable to mark the books—and are fitted into slotted end pieces as shown. These slotted pieces are secured to the edges of the easel-board by means of wing screws (ordinary tripod screws) working in brass bushes. The pair serves to hold the page of the most bulky volume as flat as one can wish. In fixing the book, the two screws on one side are secured so that the rods lie flat over the page, and the book is

then clamped down by springing down the free ends of the rods and making fast the screws.

Nicol's Copy Board

It may be of service to show another pattern of apparatus devised for the same purpose by Dr. W. W. J. Nicol, the inventor of the Kallitype process. It dates back some twenty years but, with a knowledge of most appliances which have come on the market, I cannot call to mind

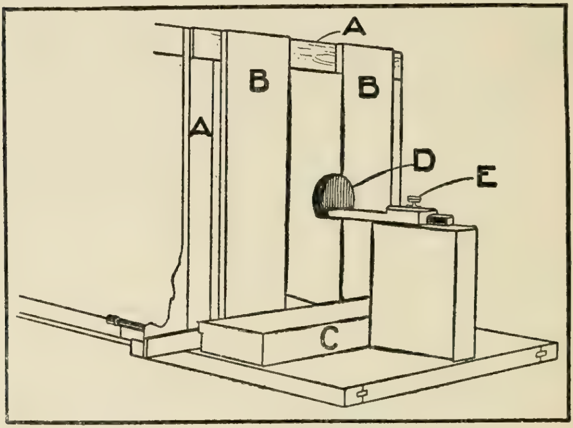

FIG. 2. Nicol's device for holding book-plate before the copying camera.

any as well adapted for the particular object of bringing the page of a book, large or small, quickly and flatly into position for photographing. The two facsimiles (Figs. 2 and 3) in line of photographs which I have of Nicol's apparatus will serve largely to explain its construction. The book-holder consists of an open frame *A* behind which slide two shutters *BB*. These are opened more or less, according to the size of the page or the part of it required, the book itself being stood on the block *C* and pressed against the edges of the shutters by the pusher *D*, which is then secured by the set-screw *E*. It should be pointed out that the camera for use with this appliance was raised or lowered, as shown in

Fig. 3, but in the absence of this movement the illustration could be brought opposite the lens by laying sufficient half-inch boards on to block *C*.

Length of Copying Stand

The reader will notice that I have said nothing about the length of the copying baseboard. It is not good policy to stint the length—five or six feet is a fair average—but I will give a rule whereby the necessary length can be figured out from the two factors which determine

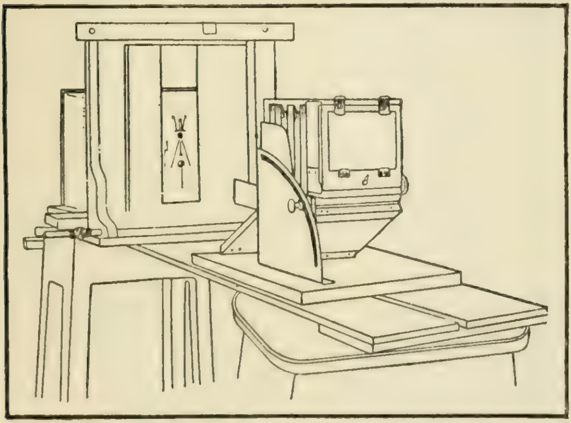

FIG. 3. Nicol's copying stand, showing device for centering camera.

it, viz: (1) The focal length of the lens and (2) the degree to which originals are to be reduced in copying. If this latter is, say, 6, i. e. a 24-inch original to be reduced to 4 inches, then the plate will require to be at a distance from the copying board equal to $6 + 1/6 + 2 = 8 1/6$ focal lengths. With a 6-inch lens, for example, this will be 49 inches. Exactly the general rule is: Multiply the focal length by the maximum degree of reduction, add two focal lengths and also one focal length divided by the reduction figure. Shorter and quite accurate enough is: Multiply the focal length by the reduction figure *plus* 3. This will give an inch or two more, but then the baseboard requires to be a foot or so longer

than even this greater length in order to allow space for the supports of camera and easel.

Other Copying Stands

The simple apparatus I have described is that which I have had in regular use for years past, but there are hosts of possible variations. One can hardly open a photographic journal without seeing some design for the same purpose which an enthusiastic copyist and an indulgent editor have conspired to make public property. The main thing is *to have* a stand and easel, either by making one for oneself or by purchasing a commercial stand. Of the use and advantages of a vertical pattern of copying camera I will have something to say after having dealt with illumination.

Copying by Daylight

Copying being essentially indoor work, it must be admitted at once that in ordinary rooms daylight is not the most convenient illumination. In almost all copying, the light should fall "dead on" to the original, not from one side or the other, and it should be even over the whole easel. The first condition is one of the things necessary in avoiding "graininess" in the copies (exaggerated grain of the paper of the original). The second is of obvious importance; if the light is not even, the copy will show the fact very plainly; unevenness of illumination which you cannot detect by the eye will show up in the copy negatives. Now with daylight, as it is obtainable from the window of an ordinary room, a position of the copying-stand directly facing the light means that the camera comes in the way. The stand must be angled to the window so that the easel has a clear view to the window, and the whole apparatus be set back a few feet into the room, as the illumination, though weaker, is then more even. Also it may be necessary to put up a reflector of white cardboard near the easel on the side removed from the window. All this is horribly disturbing to any domestic apartment, but, apart from conjugal difficulties, it is unsatisfactory for the reason that neither the strength nor the distribution of the light can be known beforehand. However, if the reader needs to use daylight, what I have just said will tell him how to go about it, with the

further reminder that it is just as well to cover the upper half of the window with a dark curtain or blind, and so to cut out light reaching the "copy" at an angle from above. But now-a-days, thanks to the perfection of electric lamps and gas-burners, either of these forms of light is most convenient, and far more satisfactory in every way unless originals are unusually large.

Electric Light Of these two, electric light is much the better. A satisfactory arrangement for originals up to 15 x 12 inches is to fit up four 32-c. p. metal-filament lamps on a frame so that they come one at each corner of a square of such size that the centers of filaments are about twelve inches apart. The sockets will be further apart than this, the two bottom lamps being placed in the upright position, and the two top ones inverted. On no account must the lamps be fitted so that the tips of the bulbs point toward the easel. That means a great loss of light; the strands of the filaments should be parallel with the copy board and about twelve inches distant from it. By choosing lamps made one quarter the voltage of the house current, the four can be wired in series and operated by a single switch. It is very important to provide the rear of the frame supporting the lamps with opaque shields (of cardboard), so that no light can strike back to the lens. Although a minor point, it is just as well to dead-black the rear side of these shields and have the front surface white to act more or less as a reflector. In a word, the electric illuminator is an open frame about 18 x 18 inches and about three inches deep and with black-white card nailed, to the width of about four or five inches, on each side of the rear of the frame, the lamp sockets being fixed, one near each end of the basepiece of the frame and one near each end of the top piece. A very simple installation, which any one can rig up for himself—or herself. For the professional copyist the Cooper-Hewitt light equipment, No. 46 or 47, is best.

Gas A pair of incandescent gas-burners of the upright pattern—the inverted mantles are not so suitable—provide a very satisfactory illumination—again, for originals of mod-

erate size. As with the electric lamps, the burners should be backed up with opaque shields, to protect the lens from direct light. These, on account of the heat, are best of bright tin-plate, dead-blacked on the rear side. The angle-pieces carrying the burners are simply secured to a cross-piece with large staples or metal stirrups, and the two short extension pieces connected to a T-piece of pipe. The third limb of the T-piece, to be connected to the house-gas supply, should be fitted with a tap so that both burners can be turned on at once. The cross-bar supporting the burners should be fitted at each end with blocks of height, to bring the mantles opposite the middle of the copy board.

It is scarcely necessary to speak of other sources of artificial light but, in the absence of both gas and electric current, there is little difficulty in finding good illumination in a pair of kerosene oil lamps, best of a good flat-flame (wide-wick) pattern. Household stores have plenty of such burners for domestic use, the only drawback of which is usually their tall build. It may be necessary to have a couple of square box-form oil reservoirs made by the tinsmith and to fit the burners to these. If this is done, see that the burner, when screwed tight, brings the width of the wick into such a position that it can be placed parallel with the surface of the easel.

Lenses and Artificial Light

There is one point with regard to the use of artificial light which I must not forget to mention. Against its great advantage of constant and uniform illumination is the minor drawback that the frame or cross bar supporting it usually forms an obstacle across the copying stand about twelve inches from the easel. Thus if the camera is fitted with a rather short focus lens—anything less than seven or eight inches—it may not be possible to move it up close enough to the original when copying same size or, still more, when making a copy on an enlarged scale. A lens of comparatively long focus, ten or twelve inches, obviates this difficulty, but with a smaller lens it requires only a little foresight and contriving to make the supports for the lamps in two separate units or in arch form so as to allow of the

camera on its base being pushed up close, its lens protected by a projecting hood which is especially necessary under these conditions.

Vertical Copying The inconveniences of daylight for copying, already referred to on page 490, largely disappear by placing the original horizontal and rigging up a stand by the aid of which to point the camera vertically down upon it. For one thing in an ordinary room, the best light obtainable is to be gotten on a surface a foot or two above the floor and about the same distance from the window. Also, if one has a stand for holding camera vertical and original horizontal, the floor-space then occupied is next to nothing compared with that for apparatus on the usual plan, at any rate not enough to disturb a room for other purposes. The vertical system is a very good one for copying small originals but, if those of large size have to be greatly reduced, it becomes awkward in use owing to the height of the focusing screen. On this account it is best to work with a lens of fairly short focus, e. g. not greater than the long side of the plate. The vertical camera is particularly useful for copying sets of small articles such as coins, medals, etc., the items can be so easily arranged on the level copy board. This latter may on occasion be of glass, and any description of background then obtained by placing a light or dark card some distance below.

Vertical Apparatus As a makeshift support for the vertical camera, a stout wooden bar can be laid across a couple of boxes, made higher, if need be, with two piles of books (Fig. 4) and the camera screwed midway to it. But, like most makeshifts, this is not at all handy in use. Much better is a rigid skeleton stand to which the camera can be screwed, with the focusing screen level with the top, and with the uprights provided with slots to support the copyboard at any required height. Fig. 5, showing a stand of this kind, sufficiently explains the apparatus. It is one devised by Mr. Jarvis Kenrick for the odds and ends of copying in photographic record work. The reader can make it of size according to his lens, originals, etc., by the rule on page 489. Those who would make or get

made a stand for every description of work may take as a pattern that designed by J. Horace McFarland, described and illustrated in THE PHOTO-MINIATURE: No. 13, or in his book on "Photographing Flowers and Trees and the Use of Natural Forms in Decoration."

Practical Work

So much for apparatus. Let me come now to the operations common to photographing any kind of original, and then pass to the special methods of development necessary, according as our copy is that of an ink sketch, engraving, painting, or other subject.

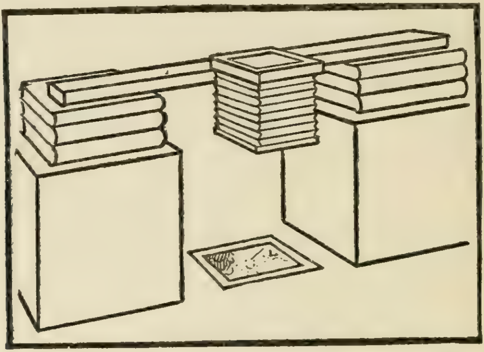

FIG. 4. An extemporized vertical copying stand.

Photographing to Scale

The first thing, after having pinned the original centrally opposite the lens, is to place the camera at the correct distance to obtain a copy of the required size. A little simple arithmetic will help here to put the camera at the right distance without repeated trials. Measure the length or breadth of the original and divide it by the length (or breadth) which the copy is required to be, e. g., $12 \div 3 = 4$. Then, for a copy on this scale, the lens should come 4 *plus* 1 ($= 5$) focal lengths from the easel. The measurement should be from the stop of a doublet or R. R. lens, and is more easily done if you use a lath marked off, not in inches, but in focal lengths and half-focal lengths of the lens in use. The camera

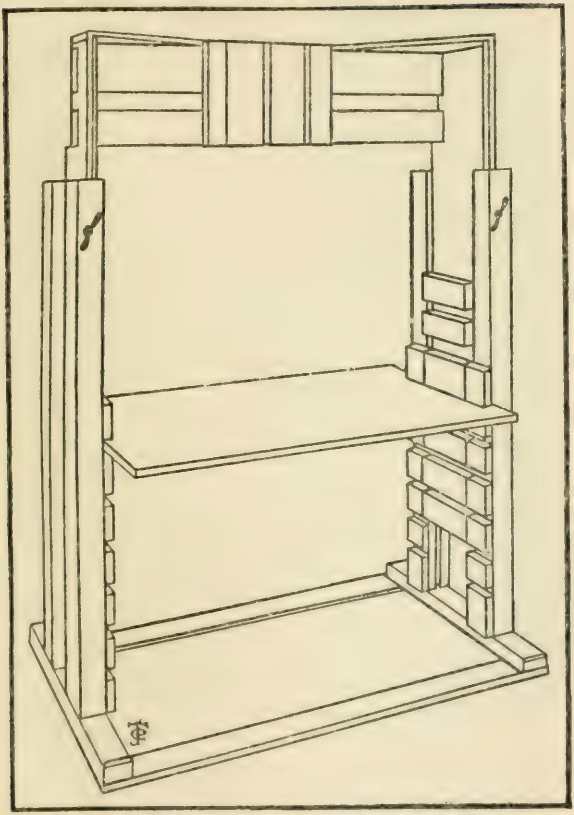

FIG. 5. An efficient vertical camera-stand—from "The Camera as Historian."

having thus been placed approximately in position, the image on the ground-glass is brought into focus by racking the camera-back in or out. From this the reader will see clearly why a rear-focusing camera is better for copying work than one with front focusing. If the camera focuses from the front, any movement of it for

the purpose of sharpening the image also alters the size of the image, and thus adds to the trouble of getting a copy to the exact size required. Even if the placing of the camera by calculation (as above) does not give just the size of copy required, it is still a great advantage to be able to make the to-and-fro movement of the lens distinct from the focusing adjustment.

Adapting a Front-Focusing Camera

If the camera is of this type it is worth while to attach a couple of small L-shaped brackets to the front of its extending baseboard (the part which carries the lens) and to fix them in turn to the platform on which the camera rests, securing the camera in no other way. The result of this is that on operating the focusing pinion the camera back, being the only part which is free to move, is thrust one way or the other, and the more speedy form of focusing adjustment thus secured. This method, of course, is applicable only where a lot of copying is in hand with uniform reduction to one size.

Focusing

In all copying, whatever the original, the aim should be to get the sharpest possible focus. Much ground-glass used for focusing screens is altogether too coarse—often as coarse-looking as loaf sugar. Dealers can supply a glass of fine matt grain known in the glass warehouses as "finely ground patent plate." It, like any ground-glass, is improved for focusing purposes by rubbing over with a little vaseline, polishing off all but the merest film, with soft paper. A good magnifier is a further great aid to certain and rapid focusing when examining the image. Get one of the compound or Ramsden type which you can adjust to your own eyes by penciling a fine cross on the ground side of the screen, and sliding the eye-piece in the tube until the cross is seen quite sharp. Then fix the eye-piece at this point, if the magnifier has a screw ring for the purpose, or make a mark on the tube as a guide to the proper adjustment in the future. There is no need to make a clear patch on the screen by cementing a microscope cover-glass on it, as sometimes advised; unless great care is used, this is liable to lead to bad focus.

Aids to Focusing

When the copy takes the form of salon fuzzitypes, and indeed whenever it is full-tone original without sharp lines or edges, it is necessary to provide lines on which to focus. As ready a way as any of doing this is to stretch across the original a bit of very fine lace, black or white, according as the original is light or dark. The lace can be kept hanging on one side of the easel and brought flat across the original by a loop of elastic attached to its free end and slipped for the time over a nail on the opposite side of the easel. This is quicker than pinning up a piece of reading matter printed in small type, which otherwise is a very good method.

Plate and "Copy" Parallel

In copying at home on a stand, there is no need to look after this point—the apparatus should be made "square"—but when working away from home, as in copying painting on walls, one should know how to test for it, otherwise the image on the negative may not be rectangular like the original and the prints will require trimming down (with loss of subject), to make them look presentable. There is no need that the lens should point "squarely" at the painting, but the latter and the plate should be parallel. The handiest way of getting things right in this respect is to rule the ground-glass each way with fine pencil lines about one-quarter inch apart. It is then easy to tell if the image is out of square, and to correct by tilting or swinging the camera back to correct the distortion.

Distorted Originals

On the other hand, it sometimes happens that one wants to introduce distortion, in order to neutralize that existing in an original, and so to produce a correct result. The most common instance is that of a print the negative of which was made with the lens pointing up, and so (in the absence of a swing back) the plate or film tilted backwards. We are all familiar with the effect—the straight lines of houses appear to converge on a point in the sky. To correct this in copying, the upper part of the print must lean forward toward the lens, and the upper part of the camera-back, carrying the plate, also lean forward to an equal angle. The

amount of tilt must be judged by the appearance of the image on the focusing screen and a very small stop used to get sharp focus. Tilting the original only or the plate only will restore the parallelism of the lines, say the opposite sides of a house front, but the copy will have a stunted, squat appearance, due to the compression of the drawing vertically in the reproduction. If both are angled to each other equally and to the requisite angle, the copy will be of the correct proportions, which would have been obtained by the proper use of the swing back or the rising front when the original negative was taken.

Telling Exposure

The beginner usually feels altogether in the dark as to what exposure to give; and well he may, since the first thing he may chance to have learnt is that, in copying, the *f* number marked on the lens ceases to have any significance as soon as the camera is racked out further than its usual distance. That is so; but nevertheless there is a rule. It is that so long as the same actual stop is kept in the lens (i. e. the iris diaphragm kept set at the same point) the exposure is proportional to the "square" of the camera extension. Square means camera extension multiplied by itself. In other words, if a seven inch *f*/6 lens is being used to copy same size (i. e. at fourteen inches extension), the real working aperture is not *f*/6 but *f*/12, and therefore calls for the requisite allowance in exposure, viz.: four times. It is just as well to understand this, but there is no need to worry over such calculations in practical work if you will make and use a measure marked off in focal lengths of your lens, instead of in inches, and if you will also find out once and for all the exposure required when copying upon a given scale, preferably same size. The rest is plain sailing, when working by artificial light, but with daylight requires a further allowance for the strength of the light.

A Working System

The first thing is to know the focal length of your lens. If this is not marked on it, you can measure it with sufficient accuracy by focusing on a distant object and noting the distance from the ground-glass to the lens-stop if

the lens is a R. R., or to the nearest glass surface if it is a single lens. All the better, to use a more exact method as described in THE PHOTO-MINIATURE, No. 140, *Lens Facts You Should Know*. Still, the above will do. Now on a long strip of wood, such as a blind lath, make a mark at the distance of 2 focal lengths from one end, another at 2½ focal lengths, another at 3, and then further marks at 4, 5, 6 and 7 focal lengths. Mark this side of the lath with a big R, to indicate it is for use when copying on a reduced scale. To each of the marks just specified a figure can be assigned, either on the lath itself, or as a separate table. This figure can be the fraction of exposure compared with that for a same-size copy, or more conveniently the actual exposure itself, as can be done after finding the time for same-size by trial. These figures are:

REDUCING THE SIZE OF THE ORIGINAL

Focal lengths	2	2½	3	4	5	6	7
Fraction of exposure at same size	—	7/10	3/5	½	2/5	⅓	⅓
Assuming same-size exposure is 30 seconds, the actual exposures will be	Sec. 30	Sec. 21	Sec. 18	Sec. 15	Sec. 12	Sec. 10	Sec. 10

So long as a stop of the same actual size is used, these figures for the relative exposures hold good for a lens of any focal length; but the reader must be careful to use, for testing exposure at same-size and for regular work, the same stop or setting of the iris diaphragm. Usually exposures are made with a fairly small stop (about $f/16$ as marked on the lens) even when a larger one can be used for focusing. How then is this lath used to indicate the exposure required? Simply by laying one end (the end with the lowest number) against the original, and noting which number comes nearest to the lens stop. It is not worth while to have the lath longer than 7 focal lengths (corresponding with a reduction to one-sixth), since at these greater degrees of reduction the exposure varies very slightly from one to another. You can give one-third the same-size exposure up to a distance of lens from original of

12 or 15 focal lengths, which is as much as is ever likely to be required.

Exposure when Copying Larger

But, on the other hand, the exposures vary greatly when copying on an enlarged scale. Use the other side of the lath for this, marking it E. Mark this side in the same way as before, but with a different series of focal lengths, starting from one end, viz:

Focal lengths.....	2	2½	3	3½	4	4½	5	6	7
Then the multiples of the same-size exposure will be:									
Times same-size exposures......	–	1½	2¼	3	4	5	6	9	12
Assuming, as before, that the same-size exposure is 30 seconds, the actual exposures will be:									
	Sec.	Sec.	Sec.	Min.	Min.	Min.	Min.	Min.	Min.
Actual Exposures.	30	45	65	1½	2	2½	3	4½	6

Note that, in using the focal-length stick when copying on an enlarged scale, the distance measured is not that from lens to original but *from lens to plate*. It is laid on the top or by the side of the camera, or can easily be fitted to be always in position on a camera used only for copying.

Actual Exposures

As a guide to finding the exposure for a same-size copy, let me give the reader a few particulars which he will find not very far wide of the mark. Electric light, four 32-c.p.; incandescent lamps about twelve inches from copy-board. With lens-stop $f/16$ (as marked on lens) and with a "process" plate, the exposure for a line original will be about 30 seconds to 1 minute. With two upright incandescent gas-burners, in good condition, about half as much again, i. e., 45 seconds to 1½ minutes. If the original is a photograph of black tone (bromide, gaslight or platinum) the exposure (on process plates) requires to be about the same; about half as much again for warm-toned prints.

Process plates (admirable for copying all kinds of original) are somewhat peculiar in not calling for very great increase of exposure for full-tone and warm-toned prints as compared with black and white lines. With medium speed plates, it will be found that a line sketch requires only about one-quarter the exposure of a full-tone print. I think the explanation is that a process plate quickly gives the requisite density in the ground, and so can receive ample exposure for a line sketch; whereas, with a faster plate the exposure must be cut down to a minimum, in order to get clear lines. But this is anticipating matters to which we will come after saying a word concerning exposures when copying by daylight.

Exposure by Daylight

The above rules as to the effect of scale on exposure apply equally to work by daylight; but here an allowance must be made also for the strength of the light. For this you cannot do better than use an exposure-meter such as the Watkins or Wynne. Have it fitted with a quarter-tint standard paper, otherwise taking a test of the light will be tediously long. Then, in finding the exposure required for a same-size copy, find also and note the time required by the meter to match the quarter-tint, hanging the meter on the copy-board. In subsequent work a test with the meter will tell you what the allowance for the light must be, e. g., double, treble, half, a third and so on. Thus supposing the meter in your standard test required 12 seconds, meter tests in subsequent work, of 3, 4, 6, 18 or 30 seconds will indicate that the exposure must be $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$ times that indicated by the focal-length stick referred to.

Different Originals

In dealing with different subjects, the secret of success is that those of one kind require entirely different treatment as regards development, etc., from those of another. What is sauce for the goose is *not* sauce for the gander. Thus, sketches in lines of pencil or ink call for a plate, development and intensification, which will yield the utmost contrast. Ordinary photographs require care in avoiding excessive or insufficient con-

trast. Colored originals make it necessary to use light-filters and color-sensitive plates, in order to record their visual effect or to accentuate it, and other subjects, e. g., Daguerreotypes, coins and medals, need special arrangement of the lighting. The four descriptions of "copy" just mentioned may be said to make up the whole field which the copyist has to cover. I will deal with each in turn in this order.

Line Sketches

The difficulty with originals like pen-and-ink sketches, line prints in books, diagrams, woodcuts, is to get a negative in which the lines are clear glass whilst the ground is a dense black deposit. The difficulty is greater the finer the lines in the copy and the faster the plate which is used. Hence it is necessary to use a slow plate, to choose and compound the developer for the greatest degree of contrast and, usually, to reinforce this means by suitable reduction and intensification. On this system, negatives can be made not far short of those by the wet-collodion process, as used by professional copyists in the making of printing blocks.

Plates for Line "Copy"

The best plate for the purpose is that sold as "process" or "photo-mechanical," of rapidity about one-tenth or one-twentieth that of an extra-rapid emulsion. Almost every maker includes such a plate among his brands. Some workers prefer to use "lantern" or "diapositive" plates for line copying, but it is not so easy to get great density on the ground with them. Moreover, they average about half the speed of process plates, and with the latter, exposures are quite long enough. For line originals in colors, there is need for a plate resembling a "process" in its general properties but sensitive to all colors. These requirements are met in the "Wratten Process Panchromatic," the use of which I deal with later in treating of colored originals.

Backing Plates

Backing is an essential for the best copies from line subjects. Without it, the sharp reproduction of fine lines will suffer no matter how good the lens or how sharp the focus. Many brands of plates are now supplied "backed" by the makers.

Exposures This should be no longer than is necessary to get ample density of ground without forcing development. The development of a line negative should be like that of a lantern, dispositive in that the image should come up quickly and develop steadily without the need of keeping the plate long in the solution, or using more of the alkali (accelerator) in order to get density. But any exposure beyond that necessary for this result is harmful in two ways: (1) It reduces the contrast between what should be clear glass and opaque deposit, and (2) it impairs the sharpness of fine lines. It is better to err on the side of under-exposure, but remember that with a line subject the exact degree of exposure is as important as in making any kind of negative.

Development The developer should be either pyro or hydroquinone. If the plate-maker's formula is for pyro, use it, but on the whole hydroquinone is better. A good formula is: *A*. Hydroquinone, 160 grs.; soda sulphite cryst., 4 ozs.; citric acid, 60 grs.; potass. bromide, 160 grs.; water, 20 ozs. *B*. Caustic potash, 320 grs.; water, 20 ozs. To make the developer, mix equal parts of *A* and *B*.

In this or the maker's developer the image should come up steadily and be of full density in about five minutes. If the plate hangs fire and remains thin, it is useless to try to make good with it (under-exposure), but bear in mind that this *may* be due to the temperature of the developer being low. It should not be below 60° F.; hydroquinone becomes almost inert much below this. If, on the other hand, the plate comes up steadily and with strong density, let it go on until the lines are a little veiled; it will lose slightly in the fixer. If the density is poor at the time, the lines begin to veil (over-exposure), it *may* be worth while to continue development much longer—until all is black—and correct afterward; but generally the result will be flat in contrast and blurry in the fine lines.

After development, line negatives should be given more than the customary rinse. They should have five minutes in running water before fixing them.

Fixing

A hypo bath of ample strength and not partially exhausted by constant use is necessary in view of the reduction and intensification processes through which most line negatives require to be passed. A fixer of 6 ozs. hypo in 20 ozs. water is not too strong, and should be allowed to act for an ample time—at least as long again as is needed for the white emulsion to disappear. Another point: Don't expose plates to daylight until rinsed from the fixing solution.

Reducing Line Negatives

There will be a little veil over the lines of the negative, however well exposed and developed. This we now proceed to remove with the Farmer hypo-ferricyanide reducer, made by adding about half a dram of 10 per cent ferricyanide solution to 2 ozs. of hypo in 10 ozs. of water. This reducer has the very good feature of acting more upon the faint deposit in the lines than on the dense deposit of the ground, but the ground will suffer in getting the perfect clearness of line which is necessary. One way to localize the action still further to the lines is to apply the solution with a pledget of absorbent cotton, squeezing most of the liquid out before applying to the negative. But never mind if the negative as a whole is thinned by the reducer; the density can be restored by a suitable intensifier but, if the lines are not thoroughly clear, the negative will not be so good as can be made.

After reducing, the plate must have at least fifteen minutes' washing in running water before intensifying.

Intensification

Of the many intensifiers which are used, the one which is the best for line negatives is that known as Monckhoven's, since it gives very great intensity of the ground and is not liable to veil the lines, so long as these have been thoroughly cleared with the reducer. The negative is first bleached through to the back in a solution of: Mercury chloride, 100 grs.; potass. bromide, 100 grs.; water, 20 ozs. Note well that both this and the darkening mixture are intensely poisonous. When bleached, the negative is washed under the tap for 15 minutes and darkened in a mixture made as follows:

Dissolve 100 grs. silver nitrate in 10 ozs. distilled water. In another 10 ozs. of distilled water in a 20-oz. bottle dissolve 150 grs. potass. cyanide, and add the silver solution to it in small doses until you get to a point at which the curdy precipitate, which forms as the silver is added and at first disappears completely, does not re-dissolve. You may not use up all your silver solution, or you may want a little more, according as the cyanide is of inferior or high quality. That doesn't matter so long as you leave off with a little of the curdy precipitate in the mixture. This latter, when flowed over the bleached negative at once, gives a dense, dark negative. It gets a little denser as the action reaches the glass side, but as soon as it is seen that this stage is reached the plate should be taken out, since the solution beyond this point will act as a reducer. Both bleacher and darkening solution can be used repeatedly. After a final ten minutes' wash, the negative is finished.

Various Line Originals

The reader need not think that it is necessary to go through the whole of the process just described in the case of every negative of a line subject. The necessity of thorough reduction and intensification exists only in the case of negatives having very fine lines in them. These choke up very readily on a gelatine plate and call for the whole process to get them clear. But where the lines (on the plate) are broader, and particularly if the original is in good black ink on a fine matt surface like Bristol board, careful exposure and development, followed by a touch of the hypo-ferricyanide reducer, will be sufficient. Here again, remember that it is better to get the lines clear than to aim at great general density throughout the plate.

Pencil Drawings

The making of a good copy of a pencil drawing is perhaps the most severe test of a copyist's abilities. One has to get the negative just the right strength (for the printing paper) to render the lines in their correct value. The process plate is again the best for these originals, but the negative does not require to be of the intense contrast obtained with the Monckhoven intensifier.

Very often it will be none too contrasty, in which case you can try a less drastic intensifier, such as the chromium (See THE PHOTO-MINIATURE No. 143), or can choose a contrasty brand of development (gaslight) paper. Whatever paper is used, it requires to be of "natural" surface in order to yield, as nearly as possible, a facsimile copy. Sometimes the ground of a pencil sketch will come out very mottled in the photograph, due to the yellowish "fixative" which the artist has used. A "process panchromatic" plate, either without a screen or with a yellow contrast filter such as the Wratten G, will avoid this dirtiness of the ground, and at the same time allow of sufficient contrast being obtained.

Half-tone Illustrations

Half-tone reproductions such as make up a large proportion of magazine and book illustrations are essentially "line" subjects though of dot pattern. In order to make facsimile copies, it is necessary to focus with the most extreme sharpness and to treat the negative as already described for line sketches. In that way the pattern of the half-tone will be retained to the maximum extent. But, as a rule, that is just what one does not want. More often than not, copies of half-tones are wanted for stereopticon slides, and the more perfect they are the more obtrusive the half-tone pattern looks on the lantern screen. Hence Prof. E. J. Wall has suggested using a very fast plate for this kind of original, with the object of blurring over the half-tone pattern while still retaining the details of the subject. This it does, no doubt, as the result of the spread of light from one particle to another in the more coarse-grained emulsion of a fast plate. A plate of this kind yields a flat negative quite unlike that on a process plate; even reduction and intensification will not give all the contrast required, but the deficiency can be made good by using a contrasty plate or paper for the positive transparency or print. Another way of achieving the same end is to use a pinhole instead of a lens, but exposures will be tediously long (ten minutes to half an hour) and fine detail is apt to suffer. Another plan by which also a process plate can be used is to place a

piece of very thin and fine ground-glass in the plate-holder, glass side next the sensitive surface, ground side toward the lens. The glass should be about 1-24 of an inch, about the thickness of the thinnest lantern-cover glasses, and will suffice for quite coarse half-tones. For those of finer screen, the ground side may be placed next the plate, but separated from it by a frame of thin card or thick paper. The camera, in either case, requires to be racked inward the fraction of an inch necessary to compensate for the set-back of the plate by the glass.

Engravings: Woodcuts

But, unlike half-tones, steel engravings, impressions from copper plates, etchings and woodcuts generally require to have their "texture" reproduced in the copies. All these descriptions of original consist of lines, differing more or less in character, and are best copied on process plates, developed, reduced and, if necessary, intensified according to the methods already described for plain line drawings. But, as a rule, they give less trouble in the way of choking in the lines, and again the use of the intensifier may often be dispensed with or one of less intense action employed.

Copying Full-Tones Photographs, etc.

When the "copy" consists not of lines, but of smaller or larger masses of tone imperceptibly merging into each other—as in photographs, wash-drawings, water-colors—there is not the difficulty of keeping fine lines clear, but one of another kind, viz., of securing a negative which reproduces these tones in correct relation, and is at the same time suited to the particular printing process to be employed. The crux of this facsimile reproduction is correct exposure, followed by development which, without dodging or tinkering, yields a fairly thin but bright, quick-printing negative. While a process plate serves quite well, it is better, on the whole, to use one of the slow "landscape" variety of about one-quarter the speed of those sold as "extra-rapid." They do not develop up hard so readily as a process emulsion, are of very fine grain, whilst their greater speed is something of an advantage. As regards developer, you must

on no account use a "hard-working" formula, like that advised for "line" subjects, nor one, like metol, which takes an unduly long time to yield vigor. Between the two are plenty of developing formulas—pyro-soda, metol-hydroquinone, or amidol—which are equally suitable. In short, choose a formula to which you are accustomed or which the plate-maker recommends, so long as it works fairly rapidly and is free from stain.

Exposure

In copying these full-tone originals, it is essential to give ample exposure. If the plate develops with reluctance and has to be kept long in the solution to get out detail in the darker parts, the result is sure to be hard, and may be defective in another respect, that of grain, of which latter directly. The exposure will vary greatly according to the color of the print. Black prints on development or platinum paper require the least exposure; those of sepia tone (sulphide or platinum toned) perhaps twice as much; and carbons or gum-prints of reddish color much longer. It is impossible to lay down a fixed rule beyond the excellent one of giving plenty of exposure to any print of warm color. In this way you will secure what should be the aim of the copyist, viz., a facsimile reproduction of the relative tones in the original

Flat Originals

On the other hand, there is sometimes the call to make the copy better than the original in the sense of being "brighter" and stronger in contrast. Using the landscape plates, there is a wide range of control, as much as we are likely to require, in developing fully, clearing the negative, if need be, with the hypo-ferricyanide reducer and intensifying. For this it is best to make up the developer full strength, by omitting the addition of an equal bulk of water to the stock solutions, which most formulas direct, and to add a grain or so extra of bromide per ounce of working developer. The negative will then gain density and contrast more readily—the bromide will keep down fog—and, if the original is very flat, you need not be afraid to over-develop to a great degree and to restore the negative to a convenient density with the reducer.

Hard Originals With photographs, on the other hand, which are hard or chalky in character, something, though not so much, can be done, chiefly in the direction of giving a full exposure and developing with a solution weaker than the ordinary, i. e., with more water added. But this is a very partial remedy, for usually the shadows of such prints are lacking in detail, and when you reduce down the depths of these blacks in the copy you only reveal, so to speak, the nakedness of the land, and very often get a washed-out forlorn-looking copy which is less presentable than the original. In such cases, one cannot do better than follow Mr. Hollinger's method of lighting the print with a brilliant, direct light, giving a fairly full exposure, and then developing in a developer of ordinary strength until the highest lights are slightly emphasized.

Line and Tone Combined Originals crop up in which both line and full-tone occur together. One common instance is a portrait photograph with a decorative design around it; another is a legal document with a seal of highly non-actinic red color. One part requires perhaps twice, or even, as in the latter instance, ten times the exposure of the other. For this, make a mask of matt orange or black paper, to cover the line part of the subject. Expose on the unshielded full-tone portion for something short of the requisite time, cap the lens, remove the mask and give the exposure for the line portion, which, with that of exposure No. 1, should make up the time required for the first portion. In this way, very difficult originals can be dealt with so as to yield results which would otherwise call for panchromatic plates, and often would not be properly rendered by them. A vertical camera is very convenient for work of this kind, as it is easy to arrange the mask in position.

Grain In copying full-tone originals, such as photographs, printed on any paper which is not positively glossy, but more particularly on rough paper, the copy often has a coarse "grainy" appearance, arising in several ways from the roughness of surface of the original.

What is Grain? The prime cause of this defect is the minute hills and depressions which make up a rough surface. You won't get grain in the copy unless the original is more or less rough; but wrong manipulation will cause the roughness to show in a very unpleasant form—often to a degree out of all proportion to the character of the original. The chief fault in manipulation is lighting the original altogether from one side or the other. The result of that is to light these small hills all on one side, and so to produce a kind of microscopic pattern, made up of tiny units, each of which is light on one side and dark on the other. The "grain" produced in this way is greatly emphasized if the plate is under-exposed and forced in development.

To Avoid Grain This explains why a flat, even lighting is necessary in photographing matt or rough subjects. Best if it comes from a point straight behind the camera, but, as that is usually not possible, see that it comes equally from each side, and is also well diffused through screens of groundglass muslin or tissue paper. In copying bad subjects, e. g., an old albumen print with fine cracks in it, by daylight, it is worth while to make a kind of tunnel between the camera and the easel out of three frames covered with tissue paper, and placed one on each side and one on top. Also let the exposure be full, so that the image comes up readily. It is the under-exposed plate "coaxed" to full vigor in the developer which shows the worst kind of grain. Where circumstances permit, the original may be soaked in water, squeegeed to glass, and so photographed; or may be rubbed over with encaustic paste: gum elemi, 1 part; white wax, 8 parts; oil of lavender, 6 parts. Either plan will avoid grain considerably, but I would caution copyists against tampering in any way with an original which comes into their hands, except with the sanction and at the risk of the owner.

Colored Originals When an original, be it in line or full-tone, is in color, it is absolutely necessary to use a color-sensitive plate and a suitable ray screen or light-filter. The one is of little

use without the other. While there are many plates on the market more or less sensitive to colors, the copyist had far better restrict himself to one of the "panchromatic" kind, in which sensitiveness to the widest range of colors from blue to red, has been secured by the plate-maker. Such a plate, in many cases, will yield a vastly better result than one which is only "orthochromatic" or "isochromatic," and the greater color-sensitiveness of the panchromatic is no drawback in cases where its full power may not be called for. Several makers now manufacture a plate of this kind suitable for the full-tone originals, such as paintings, posters, carpets, wall-coverings, linoleum, which are the descriptions of colored subjects most frequently requiring to be reproduced. For line subjects in color, there is the Wratten "Process Panchromatic" in which the contrast-giving quality of a "process" emulsion is combined with panchromatic color-sensitiveness. Either variety of plate requires to be handled in darkness or in a green-safelight, as supplied by the maker for it, until it is fixed; but, apart from this and the use of light-filters calls for no special treatment. As regards the use of light-filters, I must refer the reader for general information to the booklets published by the various makers of panchromatic, orthochromatic and isochromatic plates and color filters, confining myself here to the special use of filters in dealing with different kinds of colored originals.

Two kinds of Originals

Apart from their character of line or full-time, originals in color may be classed in two divisions as regards what the copyist has to do with them. In the one, usually those containing many different colors, the aim is to make a copy which, as nearly as can be done in monochrome, reproduces the impression of the original upon the eyes. Often this is a very difficult problem and one which not infrequently is a matter for compromise as regards one color or another, at the judgment of the photographer, but it is distinct from the other class of subject, consisting as a rule of only one or two colors. Here the aim is often not to reproduce the original as it appears to the eye—still less, as it would be rendered

on an ordinary plate—but by the choice of a suitable filter to cut out certain colors and so to produce an improved effect. The principles of these methods cannot be discussed at length in this monograph, but briefly it may be said that with the first class the method is to use a yellow filter of such depth as to cause the colored rays to act on the panchromatic plate in proportion to their visual brightness, or to depart from this condition as the subject may require, whilst with the second the method is to use a filter which completely absorbs the color to be rendered as black, and so picks out one color or another from the original.

Paintings

Oil and water-color paintings will usually require to be copied by daylight. Unless quite small, they are outside the scope of the apparatus described on an earlier page. Most usually too they are glazed, a fact which gives rise to a general fogginess of the copy and often to definite markings, unless precautions are taken. This arises from the fact that the surrounding room is faintly reflected in the glass over the picture and the reflection is photographed on the plate. Sometimes a light object facing the painting but situated to one side or the other will be reflected to the lens and cause a definite mark on the negative. This may be avoided by examining the painting whilst placing the eyes close to the front of the lens. A very slight tilt of the painting will throw the reflection off along a path which misses the lens, but the most effective means, and that used by professional copyists of paintings, is to rig up a large black screen facing the painting, or rather a pair of black curtains between which the camera lens can project. The painting is thus faced by a dark wall, reflections from which do no harm. The curtains are fastened together at the top, and the pair can then be outstretched on a couple of bamboos.

Lens and Lighting

In photographing away from home, in places where frequently the painting cannot be moved from its place on the wall, you need to be provided with lenses of different foci and to use the longest which space permits, as there is then less trouble from reflections and less need

to tilt the camera. Often, too, the lighting has to be taken as one finds it. About the best position for the painting is at an angle of 75° to the wall in which is the window, i. e., angled a little toward the wall from a right-angle position and far enough inside the room to get an even lighting. But very often a better illumination can be gotten outdoors and, for dark paintings, preferably in direct sunlight.

Plate and Filter

In the general run of copying paintings, the panchromatic plate (backed) requires to be used with a deep light-filter. The Wratten Panchromatic with the K 3 filter may be instanced, as it is probably the most widely used combination for this work. The one is adjusted to the other in order to give a reproduction in which the tones are in proportion to the apparent brightness of the colors: But, according to the character of the painting, it is advisable to use a stronger yellow filter, e. g., the Wratten G, which, by cutting out more blue, will render a blue sky somewhat darker and so emphasize clouds in the subject. If reds come out too light, a K 2 instead of the K 3 filter may be used.

Some Difficult Subjects

Difficult, that is, on ordinary color-blind plates, but easily dealt with on panchromatic plates and a suitable filter. One is typewriting in violet ink on white paper. On an ordinary plate the violet ink photographs almost as white as the paper, but by using a Process Panchromatic with the Wratten green, B 2 filter or red A filter, the lines will be rendered a full black in the positive, since either of these filters absorbs the violet rays to be rendered as black. Another subject is an engineers' blueprint in white lines on a blue ground which, again on a Process Panchromatic, comes out in bold black and white when using the Wratten A or F color screen.

Yellowed Prints

Photographs in which the ground has yellowed with age—the most common form of so-called "fading"—come out very badly on ordinary plates. The ground, being of a non-actinic hue, photographs much darker than it looks; with a panchromatic plate and a strong yellow

filter, the Wratten G, the original is photographed by the rays which it reflects, i. e., red and green instead of those (violet and blue) which it absorbs. These are common examples met with in every day work, and they will serve to illustrate the principle on which a copy in good contrast may be had from almost any kind of colored original. This specialist work is now rendered extremely certain by the use of the charts showing the absorption and transmission of their various filters issued by the Wratten division of the Eastman Kodak Company.

Daguerreotypes

These prized relics of the early days of photography are by no means easy to copy, owing to their strongly reflecting surface. They must not be placed on the easel in the ordinary way, but should be arranged at the back of a fairly deep box lined with velvet, the lens being pointed at the picture through a hole cut in a black cloth flap which covers the front of the box. Light is admitted through openings at the side of the box. This means a long exposure and calls for proper stability of the apparatus, but it is the means of avoiding one cause of pale and washed-out looking copies, viz., the reflection of surroundings to the lens by the metal Daguerrean plate.

Developing Daguerreotype copies

A further means is the development. I quote here the advice of Mr. W. M. Hollinger, whose fine copies of Daguerrean positives add emphasis to it. It is: Develop for the high-lights and let the shadows of the subject look after themselves. With a sufficient but not excessive exposure, the plate is carefully watched in development and taken to a stage giving vigorous high-lights. The shadows and the detail therein will then be satisfactory, and the prints will be of a vigor (without harshness) very often much better than that of the original picture.

Restoring

It is often directed to restore Daguerreotypes before copying, by removing the superficial tarnish with potass. cyanide solution; but I would caution the reader as to the very delicate nature of the Daguerrean surface. A

touch with the finger may ruin it beyond all restoration. Often it is sufficient to remove the metal positive carefully from its case and to dust it *lightly* with a soft camel's hair brush. Mr. Hollinger tells us that he rarely does more than this; but if it is thought well to do more, the process consists in flooding the plate once or twice with a 3 per cent potass. cyanide solution, whilst the plate is held by one corner with a pair of pliers. Within a minute or two the tarnish will be cleared off, leaving the picture fresh and brilliant. It is then carefully rinsed in gently running water, and next comes the most tricky part of the process, viz., drying without leaving any markings on the plate. First rinse in distilled water, remove it (still by the pliers) with one corner pointing slightly downward, and keep this corner so during the drying. This will avoid the water running into drops. Let the plate thus drain for an instant and then hold it over a spirit lamp (not a gas flame), so that it dries downward from the uppermost corner. Use the most moderate degree of heat and, as soon as the plate has dried, return it to its case and carefully re-bind.

Glass Positives

The collodion positives on glass known as Ambrotypes have a surface which often is even more delicate than that of a Daguerreotype, and can be rubbed clean away by a touch of the finger. These positives are really negatives, which are caused to look like positives by a backing of black varnish or velvet. Hence one or the other may require renewing before photographing, but the front or film side should on no account be tampered with. In copying, the method is that already directed for Daguerreotypes.

Coins and Medals

These are subjects in dealing with which the vertical copying stand saves an immense amount of labor. The two chief difficulties are to avoid the reflection markings and to show up the coin, etc., in proper relief. As regards the former, the best results were formerly gotten by making casts of the coins in plaster of Paris and photographing them, but some few years ago Mr. Harold Hood introduced the simple dodge of deposit-

ing white magnesia on the coin by allowing the smoke from burning magnesium ribbon to reach it. Another method is to spray with gray color from an air-brush. To enhance the relief, the light requires to be highly concentrated and unscreened. If an arc lamp is available, there is nothing better, placing it to one side of the coin and, of course, excluding any other illumination. Daylight, admitted as a narrow beam through an aperture in the shutter of a window, can also be used. For these originals, the slow landscape plates, as used for ordinary full-tone originals, are the best.

Where it is needed to obtain the obverse and reverse of one or several coins on a single negative, the method is to cut a thin piece of wood with a number of circular holes in it, and to cover one side with gray cloth or paper, removing the material from the holes. The other side is glued, a piece of black velvet laid on it, and a stiffening card glued on to that. The coins are placed, obverse sides outward, in alternate holes, photographed, each then placed, reverse side outward, in the vacant hole alongside each, and the plate again exposed.

GEORGE E. BROWN.

BOOKS

The only books available likely to help the reader in his copying work are the various pamphlets relating to the reproduction of paintings and colored originals, published by the principal makers of dry plates, and "The Photography of Colored Objects," by Dr. C. E. Kenneth Mees (second, revised edition), profusely illustrated. Price 50 cents.